THURSDAY, OCTOBER 22, 1914.

EXPERIMENTAL AND PHILOSOPHICAL BIOLOGY.

(1) *Experimentelle Zoologie.* By Dr. Hans Przibram. 4. Vitalität. (Lebenszustand.) Pp. viii + 179 + x plates. (Leipzig and Wien: Franz Deuticke, 1913.) Price 10 m.

(2) *Mechanism, Life and Personality.* An Examination of the Mechanistic Theory of Life and Mind. By Dr. J. S. Haldane. Pp. vii + 139. (London: John Murray, 1913.) Price 2*s.* 6*d.* net.

(1) FROM the point of view of an experimental zoologist, Dr. Przibram has made a very valuable study of the distinctive characters of organisms, which may be ranked in three groups —structural, chemical, and functional. Organisms have a heterogeneous structure, showing at least cytoplasm and nucleoplasm, and they develop by self-differentiation. Organisms also show chemical differentiation, being built up of heterogeneous proteids in a colloidal state. Organisms grow in an active way; they utilise food different from themselves; they multiply in a manner certainly different from the division of crystals; they often show apparently spontaneous movements; and they have an unusual power of preserving impressions of previous states. It is interesting to notice how little agreement there is as yet among biologists as to the best way of stating these general characters of organisms. Przibram's is marked by a desire to avoid any exaggeration of the apartness of living creatures or any discouraging of the methods of mechanistic interpretation.

It is experimentally possible to mimic, with inorganic materials, the growth, movements, and even division of simple organisms, and a bowl of gelatine may illustrate the power of retaining traces of previous influences after the original conditions have been restored. Many beautiful experiments point to the conclusion that the geometrical forms displayed by many organisms, *e.g.* in their shells and skeletal parts, are expressions of the properties of the "aggregation-state" of the protoplasm. The polarity, likewise, of an organism admits of interpretation in terms of the "layering" or zonal distribution of different kinds of substances, and in similar ways.

The rapid advances of synthetic chemistry (only possible, however, through the directing intelligence of the chemist), show that we must not make too much of the chemical complexity of the proteids so characteristic of organisms; the difficulty as to the optically active nature of vital organic substances may be overcome; and the fact that fermentation- and oxidation-processes are slower when the living vehicles, *e.g.* yeast and red blood corpuscles, are absent, may be due to the greater concentration afforded by the organisation of the living cells. Living implies action and reaction between the organism and its environment; the continuance of the creature's activity depends on its structural organisation and on its specific series of chemical processes; violent death ensues when changes in the complex environment (chemical reagents, humidity, concentration, pressures, gravity, electricity, radiant energies, and temperature) fatally disturb the chemical processes, or break down the structure, or prevent the persistence of the organisation by disarranging the chemical routine.

Przibram has made many observations on the rate of growth in different types, and his general result takes us back to Herbert Spencer. A doubling of the mass of the living cell leads to the break-down of that cell, and the process is comparable to the "autokatalysis" observed in some non-vital chemical transformations. Surely in its movements, at least, the animal is spontaneous and unique. But the author bids us consider all the taxisms and tropisms—the inevitable responses which the creature makes in response to external stimuli—of light, heat, pressure, humidity and so on. He seems to us to lay on the shoulders of taxisms and tropisms a burden heavier than they can bear, and we do not think that what Jennings observed of an amœba on the hunt can be fully redescribed along these lines. It is plain, however, that the interpretation in terms of taxisms and tropisms must continue to be worked for all it is worth until we get quite below the stage of opinions. In answer to the common criticism that we see different answers given by the same or similar organisms to precisely similar stimuli, Przibram admits that we must take account of the physiological condition of the organism as affected by previous experiences, both personal and racial. This is a crucial point —whether inorganic bodies can be said to have "duration" in Bergson's sense—the power of continuing the past into the present. Przibram admits that living creatures have the power of registering the past in a notably high degree, but he declines to credit them with the exclusive possession of this quality, recalling for instance the facility with which a piece of steel is magnetised after it has been magnetised before.

As regards transformations of energy, organisms are marvellous engines, but they conform to the laws of thermodynamics. The conclusion arrived at is that we cannot assert that there operates in organisms any form of energy which is not

known in the inorganic domain. Of course, we have our psychical life, but can we say that this makes a thoroughgoing distinction between organisms and inanimate bodies? How can we tell? Thus there ends a masterly book—scholarly, keenly critical, and rigidly objective. We do not think that the author shows the sufficiency of chemico-physical formulæ for the description of the phenomena of life, but we have the strongest admiration for his searching criticism of the doctrine of the autonomy of the organism. His book should be read along with Johnstone's "Philosophy of Biology."

(2) "The time is now more than ripe," Dr. Haldane writes, "for bringing the great biological movement of the nineteenth century into definite relation with the main stream of human thought," and his lectures form an important contribution towards the fulfilment of this task. The first lecture contrasts the mechanistic and the vitalistic interpretations. The former is certainly good so far as it goes, for the living creature can be usefully considered as a very complex material system, conforming to the laws of dynamics, exhibiting physical and chemical processes that are in line with those of the inorganic world, and as for consciousness (if that be demonstrable) it makes no difference to the energy balance whether the organism is conscious or not. It is true that the activities of the organism are very wonderfully co-ordinated towards securing the survival of the individual and the race, but it is replied that there are effective nervous and chemical means which secure this co-ordination, and have been wrought out in the course of untold ages of variation and selection. It has to be admitted, however, that what goes on is more complicated than the working of any machine known to man; that mechanical interpretations of such functions as excretion and respiration have had to be abandoned from time to time because they did not cover the facts; that heredity, variation, and development seem facts *per se*; and that the organism is strangely autonomous. For these and similar reasons there is periodic reaction from mechanism to vitalism.

"Vitalism assumes that the intimate processes are guided or controlled by an influence which is manifested only in living organisms, and which acts in a manner wholly different from anything known in the inorganic world."

To Dr. Haldane the theory of vitalism is no more acceptable than that of mechanism. For if a vital principle controls what goes on in the organism, can it do so without a breach in the conservation of energy; and if it guides, how does it know how to do it? The hypothetical vital principle is unproved, unintelligible, and useless. In this chapter, the answer to Driesch's argument from embryonic development seems to us very far from clear.

The second lecture contains a criticism of the mechanistic theory. It has been useful in stimulating research, but it is inadequate for the re-description of what is essentially vital. A minute increase in the hydrogen ion concentration of the blood induces an intense activity of the respiratory centre, but we do not know the chain of events between the stimulus and the response.

"In the case of stimulus and response there is in reality no experimental evidence whatsoever that the process can be understood as one of physical and chemical causation."

Or what are we to make of the "recovery of functional activity after destruction of centres or nerve paths on which this activity normally depends?" Moreover, the fact is that "physico-chemical explanations of elementary physiological processes are as remote as at any time in the past." Even if we could picture the vast assemblage of delicately-adjusted cell-mechanisms, keeping themselves in working order year after year, keeping in exact co-ordination with all the other cell-mechanisms, and so on, how can we conceive of this condensed into a germ-cell, uniting with another germ-cell, and then developing afresh. And the difficulty of thinking mechanically of reproduction recurs when we picture the continual renewal of cells and plasm within the body, the ceaseless work of maintaining a structural and functional specificity. Dr. Haldane concludes that "the phenomena of life are of such a nature that no physical or chemical explanation of them is remotely conceivable." In speaking of the mechanistic view of the germ-plasm, the author says, p. 58: "On the one hand we have to postulate absolute definiteness of structure, and on the other absolute indefiniteness." But it seems to us that the word indefiniteness is here used in a sense not inconsistent with definiteness, namely, in reference to the number of divisions that may occur. If we understood *one* division, we should not boggle over an indefinite number of them.

In his third lecture Dr. Haldane turns the tables on the mechanists. The physical and chemical concepts are, after all, but working hypotheses; the notion of a real and self-existent material universe does not survive Hume's criticism. In any case, when we pass to the world of organisms we need new concepts, especially that of the living organism, a specific entity, actively maintaining and reproducing its individual structure, with functions which are determined in definite relation to the whole unified

activity, an autonomous active whole. "The conception of organism is a higher and more concrete conception than that of matter and energy." In the ruins of the atomic theory, it is already being extended to the whole of nature. "We are not seeking to reduce the organic to the inorganic, but the inorganic to the organic." To us it appears unnecessarily dogmatic to assert that "there is not the remotest possibility of deriving the organic from the inorganic." Would it not serve to say that we cannot think of the origin of organisms from the inorganic world, if the reality of the latter is supposed to be exhausted by the current concepts of chemistry and physics? And are we not bound in fairness to admit that while the physical and chemical formulæ need not be regarded as exhausting the reality of the inorganic world, they serve for certain practical purposes exceedingly well, and must bear a definite relation to reality since we successfully stake our lives and our reputations (as scientific prophets) on their validity.

The fourth lecture finds a philosophical foothold in the recognition of personality as the central fact in the world. We may consider a man as a material system weighing seventy kilogrammes, and this partial and abstract way of looking at him is sometimes of use; we may also consider him as an organism, maintaining specific structure and activity, and this is also useful; but we get nearest the real man when we know him as a person. Personality—mere organism—matter: "the relation is simply one of different degrees of nearness to reality in the manner in which phenomena are described." But personality is more than an individual concept; "the personality of any individual is the spiritual inheritance of ages; the individual participates in the life of the species; personality includes within itself our whole universe. We know extremely little about what we call matter; "the reality behind the appearance of a physical world has and can have no existence apart from personality." And thus, as the physiologist in his first two lectures sought to lead us away from the error of mechanism, so the philosopher in the last two seeks to lead us to the conclusion that the world, with all that in it is, is a spiritual world. But the realist has also something to say for himself!

FUELS FOR POWER PRODUCTION.

Fuel: Solid, Liquid, and Gaseous. By J. S. S. Brame. Pp. xv+372. (London: Edward Arnold, 1914.) Price 12*s.* 6*d.* net.

MR. BRAME'S treatise is one of a long succession of books dealing with the general subject of fuels, but in view of the wonderful rapidity with which processes relating to fuel manufacture and its preparation are changing, and of the new uses to which the fuels are put when made, there is ample room for new-comers. The author writes specially for the large class of readers to whom power production is of chief importance, and he has produced a volume which will be an extremely valuable addition to their bookshelves.

The subject divides itself naturally into three divisions—solid, liquid, and gaseous; Mr. Brame discusses each separately, and adds a section on fuel analysis, calorimetry, and the control of fuel supply. Under the title "Solid Fuels" are included wood, peat, coal, coke, coalite, and the minor fuels; liquid fuels include petroleum and tar oils with their derivatives, together with alcohol. The longest section, that on gaseous fuels, contains an account of the manufacture and properties of water gas, of Siemens and Dowson gas, and of blast-furnace and coke-oven gases.

Well-informed as the author appears generally to be, he makes a strange omission when discussing the velocity of flame propagation in an explosive mixture—the stranger in a book bearing specially in view the production of power—in that he omits reference to the striking influence on this velocity of "turbulence" in the gaseous mixture. As Clerk has shown in the reports of the Gaseous Explosions Committee, turbulence is of first importance in influencing the velocity with which the explosion spreads to all parts of the gas, and that except for this no high-speed gas or petrol engine would be able to run at the speeds necessary for their effective use.

The Bonecourt system of surface combustion is described briefly, but perhaps as fully as can be expected in a book dealing with fuel itself rather than with its manner of use. The author compares the 90 per cent. efficiency of this system when applied to the heating of steam boilers with the 55 to 65 per cent. which is usual with coke-oven or blast-furnace gases used in the older way. This improved method of steam raising is potentially of great practical importance, and we are glad the author has found space to include a number of interesting efficiency figures.

Under the title "Economic Aspects of Liquid Fuel" the author discusses the present situation in which fuel users are placed owing to the rapid change in price. He reiterates the relative insignificance of the annual oil output compared with the coal output, and affirms his belief in the possibility and the economic advisability of the production of alcohol for power uses. This is one of the best parts of the book, and the author is assuredly correct in saying of industrial alcohol:

"Its adoption would give encouragement to agriculture; it would provide a national weapon to fight artificial (or economic) shortage of other fuel for internal combustion engines; indirectly it would encourage the further development of a big and growing branch of engineering, the success of which is impossible without an assured supply of fuel at a reasonable cost."

H. E. W.

MODERN PRACTICE IN THE EXTRACTION OF METALS FROM THEIR ORES.

The Metallurgy of the Non-Ferrous Metals. By Prof. W. Gowland. Pp. xxvii+496. (London: C. Griffin and Co., Ltd., 1914.) Price 18*s.* net.

THIS book is a most valuable addition to the series of metallurgical text-books published by Messrs. C. Griffin and Co. It gives in a concise but wonderfully complete form the up-to-date practice in the extraction of the following metals from their ores: copper, lead, gold, silver, platinum, mercury, zinc, cadmium, tin, nickel, cobalt, antimony, arsenic, bismuth, and aluminium. Under the heading of each metal are considered (1) its physical and chemical properties; (2) the alloys of which it is the chief constituent; (3) the composition and applications of commercial brands; (4) the chief ores and processes by which the metal is extracted from them and rendered suitable for industrial or other purposes; (5) the principles and conditions on which the success of these processes depends; and (6) examples of actual practice in important extraction works. The author states that special attention has been given to the metallurgy of gold, silver, copper, and lead, which undoubtedly constitute the most important members of the above group. This statement is thoroughly justified, for, so far as we have been able to ascertain, every important modern successful process has received attention.

In writing this book the author has had in view not only the student engaged in a course of metallurgical training, but also the man who is actually dealing with practical problems; and he is particularly well qualified to present both these important aspects of the subject. It is perfectly true, as he points out, that much valuable information with regard to modern metallurgical practice may be found in technical periodicals and the proceedings of societies. Those who have the opportunity of consulting such publications will, we think, find his critical comparisons of similar processes of great value, while to the man whose time is limited or who has no technical library within reach the book will be one of the most valuable that has ever been published. The clear and full table of contents enables a reference to any particular process, and, indeed, to any special feature of it, to be readily made.

The author writes with rare, indeed, almost unique, knowledge of the metallurgy of copper, and his mastery of the subject cannot be better illustrated than by mentioning that in the compass of eighty-one pages every important aspect is dealt with. The ore now being pyritically smelted at the Tennessee Copper Co.'s works at Copperhill runs rather lower in copper than the figure 2 to 2½ per cent. mentioned by him (p. 100); it does not exceed 1·9 per cent., and is tending to become even lower in grade. We think that the Chilian Mill might have received more attention than the three lines devoted to it on p. 208. At the present time almost, if not quite, all the Cripple Creek gold ores are reduced by Chilian mills, the Stamp Mill having been practically superseded in this district. Harker's value of 1710° C. is given for the melting point of platinum. It is now generally recognised that this figure, which was obtained on the thermo-electric scale by extrapolation, is too low. The value 1755° C. quoted recently by the Bureau of Standards is probably much nearer the true figure.

SCIENCE AND INDUSTRY.

The Co-operation of Science and Industry. By S. R. Illingworth. Pp. 91. (London: C. Griffin and Co., Ltd., 1914.) Price 1*s.* 6*d.* net.

THIS little book has a special interest at the present time. The author deals with the history of science as applied to industry, and while avoiding any violent diatribes against the supineness of the British manufacturer, he points out what may be done to recover the supremacy of our trade. The employment of more scientific men in most of our works is strongly advocated, not only of the higher class of research men, but also of the class of routine analysts. The first class is required to devise new processes along scientific lines, to discover uses and outlets for bye-products, and always to be on the look-out for methods for gaining the maximum yield of finished products at the minimum of cost.

"To many business men the employment of such a man may appear a luxury; almost a gamble! The few that have such men are only employing them for some specific object, and maybe will rest content when that object is attained. Such an attitude is fatal."

If the German manufacturers had been content to take this line, the magnificent industries which they have built up would certainly not have come into existence. We have now, at this moment, an opportunity of recovering the ground we have lost.

The Government Committee on the Chemical Trades is composed of men who will command the confidence of everyone, and their recommendations will have great weight. It must not be forgotten, however, that nearly all trades would be benefited by scientific help. The attitude of mind induced by scientific education is just the one required for the successful development of a business. If the manufacturers as a whole would realise this, they would see to it that their sons or those who are to carry on their business, have a thoroughly good scientific education, such as may now be got at many of the Universities and technical colleges in the country. It is not the classical or the modern side of our schools which is going to supply the successful manufacturer of to-morrow, it is the side where a man is taught to bring all his useful knowledge to bear on the achievement of success. Mr. Illingworth's book is the most successful attempt which has been made to explain the situation, and we believe that if the Government would send a copy of the book to each manufacturer in the country, the cost would be a mere nothing compared with the effect which would be attained.

OUR BOOKSHELF.

A Little Book on Map Projection. By Mary Adams. Pp. viii + 108. (London: George Philip and Son, Ltd., 1914.) Price 2*s.* net.

IT is very satisfactory to find that at the present time care is being taken that the principles of map projection are being studied as soon as the use of maps is seriously undertaken. At one time this part of their subject was much neglected by geographers, and left to those whose mathematical aptitude was especially developed. In this book Miss Adams aims at meeting the needs of the secondary and the higher elementary schools; and in clear and simple language sets forth the difficulties of an adequate cartographical representation of the earth's surface. Simple explanations are given of the principal types of projection, and then the distortion of the original spheroidal surface when it is represented on a plane surface is explained, and the compromises which have to be adopted are set forth. After this preliminary exposition, into which no mathematics enter, there follows a more detailed discussion of the principal zenithal, conical, and cylindrical projections, as well as certain special projections. These are illustrated by diagrams, and the explanation which is given of each should enable anyone to obtain a clear idea of the essential character of each kind.

A short appendix gives a more mathematical account of Mercator's, the Zenithal, and Mollweide's projection, but with this exception no demand of any but elementary mathematical knowledge is made upon the reader.

A short bibliography, which might be usefully extended by the inclusion of some well-known German and Italian works, shows the student where he may find a more advanced treatment of the subject. The book is carefully written and well adapted to those for whom it is intended, and, while it cannot give them that complete knowledge of the subject which mathematical treatment alone can supply, it will pave the way to an intelligent appreciation which is of the utmost value to all who use maps.

Chemical Engineering: Notes on Grinding, Sifting, Separating and Transporting Solids. By J. W. Hinchley. Pp. viii + 103. (London: J. and A. Churchill, 1914.) Price 2*s.* 6*d.* net.

IN this series of articles, reprinted with some additions from the *Chemical World*, Mr. Hinchley provides, for the use of students intending to take up chemical engineering, a concise and practical outline of a subject of wide scope. The articles are illustrated with seventy sketches and diagrams, and their thoroughly practical character will be much appreciated by students of this branch of technology.

LETTERS TO THE EDITOR.

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Fizeau's Experiment and the Principle of Relativity.

IT is well known that the principle of relativity gives for the velocity of light in a moving medium the expression

$$\frac{c}{\mu} + kv, \text{ where } k = \left(1 - \frac{1}{\mu^2} - \frac{\lambda}{\mu}\frac{\delta\mu}{\delta\lambda}\right)$$

where v is the velocity of the medium, and c/μ is the velocity when at rest. The repetition of Fizeau's experiment by Michelson and Morley gave for water the value $0{\cdot}434 \pm 0{\cdot}02$ for the coefficient k, whereas the value of the theoretical coefficient, taking the known values of μ and λ for sodium light, is $0{\cdot}451$, which is well within the limits of the possible error.

The experiments of Gutton (*Journ. de Phys.*, ii., p. 196, 1912) show clearly that in the case of a very dispersive medium like carbon disulphide the velocity of propagation of nearly homogeneous light is the group velocity, and not that of an absolutely monochromatic train of waves. If this is universally true, as Lord Rayleigh and Gouy have predicted, then in the expression for the convection-coefficient k, the symbol μ must stand for the ratio of the velocity of light in free space to the group velocity. If we call the ordinary coefficient of refraction μ_0, we have

$$\mu = \mu_0\left(1 - \frac{\lambda}{\mu_0}\frac{\delta\mu_0}{\delta\lambda}\right);$$

neglecting the square of $\frac{\lambda}{\mu_0}\frac{\delta\mu_0}{\delta\lambda}$ (*i.e.* of $0{\cdot}014$) and terms of the same order, we have

$$k = 1 - \frac{1}{\mu_0^2} - \frac{\lambda}{\mu_0}\frac{\delta\mu_0}{\delta\lambda} - \frac{2\lambda}{\mu_0^3}\frac{\delta\mu_0}{\delta\lambda} + \lambda\frac{\delta}{\delta\lambda}\left(\frac{\lambda}{\mu_0}\frac{\delta\mu_0}{\delta\lambda}\right)$$

If we take the dispersion-formula of Ketteler and calculate the values of the two last terms in this

expression, we find that they are respectively $+0.016$ and $+0.022$, so that the theoretical value of k becomes $0.451+0.038$, that is, 0·489. This even is in worse agreement with the experimental value 0·434 than the value 0·451 usually given, but a consideration of the experimental conditions shows that the value to be deduced is in reality 0·492, which is in excellent agreement. The argument will shortly be published in full.

E. CUNNINGHAM.

St. John's College, Cambridge, October 14.

Flint Fracture.

IT is to be regretted that the letter of Mr. Reid Moir in NATURE of September 24 has received no reply. If chemists, mineralogists, petrologists, and physicists could have been made to realise the fruitful fields for profitable and far-reaching research opened to them by this subject, our knowledge would be in a very different state to-day, and many of the contentions and mysteries would be replaced by demonstrable facts.

In all text-books we see descriptions, or references, to lydite, the touchstone of the goldsmith, and in museums and collections we see specimens bearing this name; all kinds of origins are claimed for it; sedimentary, volcanic, metamorphic, and one has even seen meteoric. In text-books we see descriptions of the pebbles in the Blackheath beds; we are told they are pebbles of flint still retaining their original black colour. As a matter of fact, they are not black flint; they are now of various colours. It is their surface that is black; the metamorphosed portion may not be thicker than tissue paper, but other examples can be found upon a sea-beach where it is an eighth of an inch thick, and from this onward until the whole is metamorphosed, and we have the jet-black mineral, which does duty under the name of lydite!

Just one more example. The same text-books describe the beautiful "Egyptian jasper"; some say the locality from which this has been derived is unknown; others venture to suggest one. One of the many metamorphoses of flint is jasperisation. We see this commence on the surface of flints (one of the things called patination); this proceeds in intensity and centrewards until the whole substance is altered, and we have the rich mottlings of yellows and browns, quite equal to those of Egypt. The so-called Egyptian jasper may be a metamorphosed British flint.

Mr. Reid Moir refers to lines radiating from the point of percussion on the fractured face of a flint; here is something for the physicist; they certainly are not "fissures," but rather lines of force (closely connected with facetted cones and stellate fracture). The best place to see these, and study them, is in asphalt or pitch. So long as the "fracture-" or "flaking-plane" maintains itself constant, *i.e.* in relation to the striking-plane, they remain fairly simple. If, however, the fracture-plane resolves, or even undulates very deeply, then a very remarkable phenomenon obtains, and the lines end in a row of cones just over the escarpment, looking like a row of pointed tents with a rope passing from the centre pole of each to the point of percussion!

The last weeks of Sir John Evans, before he took to his final bed, were spent in studying a large collection brought together to put the whole subject of lithoclasiology on a scientific footing. His last words to the collector were: "Promise me that if I do not pull through this operation, you will lose no time in publishing all this. I am certain that this is where we ought to have started sixty years ago, and no real progress will be made until we start here."

If we take half a dozen pieces of flint of exactly the same shape and size, and apply exactly the same force, administered in exactly the same manner, and of exactly the same intensity, the results may be very different in each case. Before we can argue from the effect to the cause, we must know something about the nature of the object acted upon. We must start with the origin and nature and varieties of silica, the various metamorphoses and molecular rearranging to which each variety is subject, and how each variety, in each state, responds to dynamic agency, whether administered by nature or man.

So also when we come to dynamics we must study every mechanical possibility, single them out, and name them, so that every observer may know what the other is speaking about. There must be no "peculiarities known only to the student," and "no features known only to myself." Each phenomenon must be capable of separate study, and receive a special name, so that all understand what they are talking about.

There are few who appreciate the splendid work which Mr. Reid Moir has been doing more than myself, but I am quite sure that if he were to restart the subject, on the lines here indicated, in a very short time he would regard the points he raises with very different eyes.

W. J. LEWIS ABBOTT.

8 Grand Parade, St. Leonards-on-Sea.

Filtering Power of Sand.

THE letter of Mr. C. J. Watson in NATURE for October 15, recommending that "Nachtblau" (night-blue) should be used for experiments on adsorption by sand, leads us to point out that so far back as 1909 we demonstrated before the International Congress of Applied Chemistry (Section IV.B, p. 7) the striking experiment in which a solution of this dye issues perfectly colourless after passing through a column of purified sand. Since this date the experiment has been frequently used for demonstration purposes at lectures on adsorption by ourselves and others.

We showed in 1909 the remarkable quantitative relations existing between the weight of sand and the weight of dye absorbed; each degree of fineness of the sand is characterised by a remarkably sharp co-efficient of adsorption, the value $\frac{\text{weight of dye adsorbed}}{\text{weight of sand}}$ being constant for the same sand to the sixth decimal place (in one series, for example, values 0·000147 to 0·000148 being obtained). The relation of these experiments to the general theory of dyeing was dealt with in the paper cited, and also in a later communication to the Society of Chemical Industry (1912, vol. xxxi.).

W. P. DREAPER.
W. A. DAVIS.

Scientific Societies and the War.

SUGGESTIONS have recently been made that certain of our scientific societies should suspend their meetings for the present, on the ground that "it is difficult to take an interest in such things just now." To those who share this feeling, it may be worth while to point out that, as already recorded in NATURE, the Académie des Sciences held its usual meeting Paris on September 7. Under that very date, in the *Times* review of the war for September, we find the entry, "Germans reach the extreme point of their advance." Among our gallant Allies, at all events, "le tour d'ivoire ne se rend pas."

W. T. CALMAN.

British Museum (Natural History), October 16.

THE X-RAY SPECTROMETER.

IT is now well known that a homogeneous pencil of X-rays is capable of reflection by a crystal provided that the rays are directed upon the crystal at the proper angle.[1] If λ is the wave-length of the X-rays, d the spacing of the crystal planes, and θ the angle which the rays make with the planes, these quantities are connected by the relation $n\lambda = 2d\sin\theta$,[2] where n is an integer.

The object of the spectrometer is to determine the value of θ in any given case—that is to say, for a definite set of X-rays and a definite set of crystal planes. The results may be classified as follows: If we use different crystals or different faces of the same crystal, but keep the rays the same, we can compare the spacings of the various sets of planes. In this way we arrive at a knowledge of the relative positions of the atoms in the crystal—that is to say, we determine its structure.

If we use the same crystal always, but examine the angle of reflection of different homogeneous X-rays, whether from the same or from different sources, we have the means of comparing the wave-lengths of those rays. We can, in fact, analyse X-radiation in exactly the same way as an ordinary spectrometer analyses light.

The new instrument resembles the ordinary spectrometer in its general construction. To the collimator corresponds a set of narrow slits limiting a pencil of X-rays, which is directed so as to pass through the axis of the instrument. A crystal takes the place of the diffraction grating, and is mounted on a small revolving table. The crystal face or set of planes which is acting as reflector is made to contain the direction of the axis of the instrument, and the crystal is turned round the axis until the face makes the proper angle with the incident pencil. The reflected ray then enters a cylindrical ionisation chamber filled with gas which it ionises. The chamber takes the place of the ordinary telescope, and the measurement of the ionisation current by an electroscope corresponds to observation by eye or by the photographic plate.

In the drawing of Fig. 1,[3] which shows the arrangement of the apparatus in plan, Q is the antikathode of the X-ray bulb. The construction of the bulb is a little unusual in that the antikathode is placed perpendicularly to the kathode ray stream; the bulb can therefore be conveniently arranged so that the X-rays leave the antikathode at a grazing angle. The finer the angle which the rays make with the antikathode, the more nearly does the source become, effectively, a "bright" line; and the narrower the line the brighter it becomes, because the "whole illumination" given out in any direction by the spot on the antikathode is independent of the direction. The law followed is not that of the illumination by a surface of uniform luminosity, but rather that of the illumination due to a number of separate sources lying in one plane, each radiating uniformly in all directions. It corresponds to the case described by Rutherford, in which α rays are radiated from a uniform thin sheet of radio-active matter spread upon a plane surface (*Phil. Mag.*, August, 1906). The arrangement is of considerable value; the more nearly is the source a bright line parallel to the slit, the "purer" is the spectrum.

The X-ray bulb is enclosed in a wooden box heavily coated with lead. The object is to protect not merely the observer but also the sensitive apparatus. The slit through which the rays pass is only a few millimetres long and very narrow, sometimes no more than a tenth of a millimetre wide. Only a small fraction of the pencil that emerges is reflected in the best of circumstances, so that it is necessary to screen off all stray radiation with great care; it must be small in comparison with the radiation which is to be measured. The side of the box is shown on the left of the photograph of Fig. 2. Adjustable slits are placed at A where the rays leave the box, and again at B, the second slit being also capable of a movement which brings it close up to the crystal, as at B′. The crystal is shown at C, and a third slit, D, is placed just in front of the ionisation chamber.

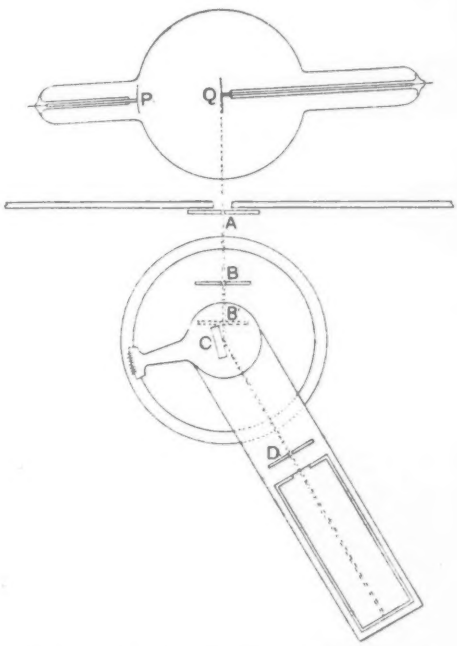

FIG. 1.—X-ray spectrometer. Plan of general arrangements.

The ionisation chamber is marked I in Fig. 2. It is a cylindrical brass chamber 15 cm. long, and

[1] A summary of the principles on which this experiment is based, and of the progress of its development may be found in NATURE of July 9, 1914, p. 424.

[2] *See* Proc. Camb. Phil. Soc., November 11, 1912, or Proc. Roy. Soc., April 7, 1913.

[3] From a book now in the press, to be published by Messrs. G. Bell and Sons.

is filled with some heavy gas, so that the ionisation current may be as large as possible. Sulphur dioxide is convenient in many cases, but methyl bromide is much better for rays which can excite the bromine X-rays. Such rays are, for example, given off by antikathodes of silver, rhodium, or palladium, the latter two of which have been much used in the determination of crystal structure, because they give off intense homogeneous rays and also stand up well against the bombardment by the kathode stream. The chamber I is insulated and maintained at a high potential, which drives any ionisation on to an internal electrode. The latter is connected by a fine wire which passes down inside the metal shield WW to the gold leaf electroscope (Wilson pattern) within the shield E. The connection with the electroscope terminal is made at a point lying on the axis of the spectroscope, so that the ionisation chamber I, the casing W, and the connecting wire may all revolve together about the spectrometer axis without straining the connection. The shielding is made solid and strong: it is necessary that the electrostatic screening should be perfect, and the electroscope must be protected from draughts which may cause changes in temperature.

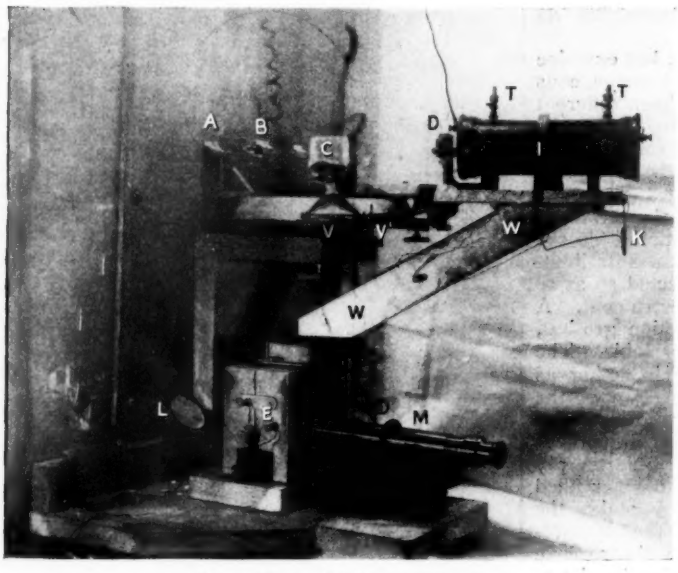

FIG. 2.—Photograph of X-ray spectrometer.

The gold leaf is illuminated by reflection from a mirror L, and viewed through a microscope M. A strong X-ray reflection will cause the leaf to move twenty or thirty scale divisions in a second.

The angular positions of the crystal and the ionisation chamber are read from verniers at V and V'. Observations can easily be made to half a minute of arc, and much finer work could certainly be done, if it were required. The actual angle of reflection can be measured with an accuracy higher than can be reached in our knowledge of certain other data used in some of the calculations; for example, the actual weights of the atoms.

Crystals are often very imperfect in construction, consisting rather of a conglomerate of smaller crystals in more or less imperfect alignment. It is interesting to observe that the spectrometer may be used in ways which almost completely overcome the evil effects of the imperfections. In the case of a very perfect crystal like the diamond, the slit at A is not used, but B is set very fine; D is wide open. The crystal is slowly turned by a tangential screw attached to the revolving table, and there is no reflection at all outside very narrow limits. The angle of maximum intensity of reflection can easily be determined to a few seconds of arc. But a crystal of rocksalt cannot be treated in this way. It is best to set A and D fairly fine and not to use B at all. On account of certain most fortunate geometrical considerations, a homogeneous pencil of some divergence issuing from A and reflected at various points on the crystal face is brought to a line focus at D, provided that A and D are at equal distances from the crystal (Proc. Roy. Soc., lxxxviii., p. 433). A perfect crystal would reflect such a pencil only along a certain vertical line on the crystal face; but a poor crystal, like rocksalt, at a number of separate points on the face. Even crystals which are scarcely recognisable as such may be treated by this method.

The higher orders of spectra, that is to say, reflections at angles for which n has a large value, three, four, or five, naturally give more accurate values than lower orders, though the intensity diminishes rapidly as n increases. The "resolving power" increases even faster than n, since $d\theta/d\lambda$ is easily seen to be equal to $\tan\theta/\lambda$, which becomes very large as θ approaches the value $\pi/2$. For example, a certain pair of lines emitted by a platinum antikathode are separated by thirty minutes of arc in the first order spectrum reflected by the cleavage face of the diamond, but in the third order spectrum they are two and a half degrees apart.

With a little practice it is quite easy to pick up the reflected X-ray. While the search is being made the slits are opened wide; as soon as the reflection is observed the slits are made narrow, and accurate measurement is then possible. It is a comparatively simple matter to find the angles of reflection of rays of given quality in the various faces or sets of planes of a crystal. The greater difficulty arises in the geometrical interpretation of the results.

THE SEA FISHERIES AND THE WAR.

IT appears possible that the British sea fisheries will suffer from the effects of the war more, perhaps, than most other national industries. Already a large part of the North Sea is closed to trawl fishing, and it may be that before long all this area will become a *mare clausum*. Since we have taken rather more than 60 per cent. of our fish supply from this sea in recent years the loss to the fishing industry is serious. The actual war losses, so far, have been insignificant, but when to these are added the loss to the national food supply of the vessels and men now engaged in mine-sweeping, the disturbance to the industry which must result from the shifting of the fishing fleets to other open waters, and the loss of the Continental markets for cured herrings, the total loss will be sufficiently great. Add to this the incalculable loss which scientific research must bear in the suspension of the international fishery investigations, and we have very much to lay to the blame of German world-politics. The co-ordinated scheme of fishery observations carried on up to last July by the maritime powers of Northern Europe was the laborious result of more than a dozen years' negotiation; probably no one then engaged in it will live to see its resumption.

Upon such industrial and scientific ruin we must endeavour to build anew, and it is fortunate that even before the war the way had been indicated. Scientific research is unlikely to suffer permanently, inasmuch as those engaged in it will turn now to domestic rather than international problems, and that this was desirable, even apart from the war, the recently published report of the Inshore Fisheries Committee indicated. It can scarcely be doubted that the increased exploitation of the lucrative fishing grounds outside the North Sea will compensate, to some extent, for the closure of that area; the enterprise of the English fishing-vessel owners has already been so marked that we need not fear this temporary set-back to the industry. Also the formation of the Fisheries Organisation Society, as the result of the Inshore Committee's report, and with the support and approval of the Board of Agriculture and the Development Commission, was a most fortunate thing, as events have turned out. This body proposes to undertake propagandist work among the inshore fishermen, and generally to take all possible steps to develop to their fullest extent the very considerable natural resources of the shallow seas and foreshores. We cannot doubt that as the result of active and far-seeing measures foreshadowed in the report to which we refer these resources may become a huge national asset in the way of amplifying the food supply and providing productive employment.

Lastly, there is the great East Coast herring fishing and curing industry—one which has already suffered greatly. It is here that propagandist measures are most urgently required, with, we suggest, some State assistance for the holding in this country of the stocks of salted herrings which might yet be obtained in what remains of the present season. Official and semi-official pamphlets and articles already published by the Board of Agriculture and Fisheries and the National Sea Fisheries Protective Association ought to have a wider circulation in order that they may familiarise the people, even well-to-do people, with the enormous supply of excellent and nutritious food in the shape of salted herrings, cod, ling, etc., which is available to the United Kingdom in times of stress. Some education for the British housewife and cook, and some persuasion that the cheapest kinds of fish are little inferior in taste, and not at all in nutritive value, to the dearest kinds are required; and the evening schools and public lectures of the coming months ought to be utilised for these purposes.

It is difficult to estimate the increase of value which industrial exploitation might confer on the raw materials of the inshore fisheries, but one could scarcely err in exaggerating this value. An enormous quantity of shrimps, prawns, and crabs are sold in the fresh (or nearly fresh) condition; by potting or otherwise preserving these raw materials employment would be largely increased, the products would lose nothing of their nutritive value, and would become much more "tasty," while they would be more easily and widely distributed. Enormous quantities of sprats can be caught during the next winter; these are difficult to sell and distribute; in many places they are nearly worthless commercially, while they are nutritious and excellent food. Why should not they be "sardined," thus again enhancing their food value, and conferring employment?

Mussels and cockles can be taken round the shores of England, Wales, and Ireland in very large quantities. For some years past there has been a market for only a small fraction of the shellfish that could be so obtained. This has been the result, almost entirely, of the prejudice that has been set up against these molluscs because exceptionally they have been the means of disseminating epidemic disease. In some cases this fear has been exaggerated, in others it has been well founded, but there can be few cases in regard to which it is not possible to remove all danger by appropriate means. It is quite certain that mussels and cockles can deliberately be laid down and fattened in water which may be polluted by sewage refuse, and then cleansed from ingested micro-organisms by relaying in clean sea-water. Here, again, a national food supply of cheap and nutritious quality can be conserved and amplified by means which also confer unskilled employment upon those who are likely to require it. Also, scarcely any attempt has yet been made to "pot" or preserve in suitable ways these shellfish, but one cannot doubt that efforts in this direction might be highly successful.

There are other fisheries which might conceivably be developed by the fishermen and the manufacturers under appropriate stimuli—the very abundant sea crayfish (or Norway lobster), for instance, a crustacean which is not inferior, either fresh or "potted," to the lobster itself. Herrings might be tinned to a much greater extent than at

present. In all these cases the stimulus or suggestion may be made by the official, but it is evident that the hope of developments along these lines lies in the enterprise of the manufacturer. Preserving, curing, and tinning are operations demanding machinery and commercial aptitude and resources. Perhaps the genius of British commerce lies rather more in business organisation, distribution, and the like, than in actual production—at least, such must have been its tendency in times of peace and prosperity. But we have seen that in such a time of national stress as that through which we are passing purely personal commercial interests have been subordinated—the price of fish, for instance, would doubtless have been higher than it is now but for a self-denying ordinance on the part of the distributing trade. National emergency may well be the stimulus to increased development of the sea-fisheries if only the public will back up efforts on the lines we have indicated. J. J.

THE TOTAL SOLAR ECLIPSE EXPEDITION TO HERNÖSAND, SWEDEN.

IT had originally been arranged by the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies that a party consisting of Prof. Fowler, Mr. Curtis, and myself, with Major Hills and Father O'Connor as volunteer observers, should proceed to Kiev in Russia to observe the total solar eclipse of August 21. However, difficulties having arisen with the Russian Government, with regard to the admission of Father O'Connor and myself into the empire, on account of the categorical law excluding Jesuits, it was found necessary to divide the expedition, and ultimately a party consisting of Father O'Connor, Mr. G. J. Gibbs, Mr. E. T. Whitelow, and myself, proceeded to Hernösand in Sweden. Leaving Hull on July 28, and Stockholm on August 2, we arrived at our destination on August 3.

Through the kind offices of Prof. B. Hasselberg, of Stockholm, the head of the Swedish eclipse committee, and the assistance of Father Wulf, of Valkenburg, who with his assistant, Father Rodés, was proceeding to Hernösand, we secured an excellent site for our instruments in a field adjoining the Technical School. Not only so, but the rector of the school, Herr Tham, with extreme kindness and courtesy, placed the whole establishment, with well-equipped laboratories, dark room, mechanical and carpenters' shops, practically at the entire disposal of the astronomers of the two parties.

Father Wulf erected his apparatus in a large lecture room facing due south, and Father Rodés had a fine coronagraph mounted equatorially in an adjoining portion of the grounds. Father Wulf made successful observations of the exact duration of totality, and the times of second and third contacts, by means of an Elster and Geitel potassium photo-electric cell. This formed one arm of a Wheatstone bridge and was balanced by a resistance of several megohms, the resistance of the other two arms being furnished by those of the battery of many cells which supplied the current to the electrometer. The difference of potential, due to the ionisation of the helium and argon contained in the cell, with a corresponding alteration in its resistance, caused by the variation in the intensity of the light falling on the face of the cell, affected a thin wire, 1/500-mm. thick, in the special electrometer invented by Father Wulf, which was displaced laterally. These displacements were recorded on a suitable drum with ample scale on the photographic film, which was clock-driven. A thin wire attached to a pendulum beating seconds passing in front of a source of artificial light gave the time scale.

Our own equipment (Fig. 1) consisted of three coronagraphs of 20 ft., 30 in., and 12 in. focal lengths, and a large spectrograph of the Littrow form. The three coronagraphs were mounted in echelon in front of a 16-in. cœlostat, being placed

FIG. 1.—The eclipse instruments, Hernösand.

in the azimuth of sunrise. The same cœlostat also supplied a beam of light to a 3-in. Cooke lens, which projected an image of the sun 4¼ in. in diameter on a graduated screen of ground glass, so as to obtain the angles subtended by the cusps at the sun's centre 10 minutes, 5 minutes, and 10 seconds before totality. This instrument was mounted above the 20-ft. coronagraph, so that Father O'Connor, operating the coronagraph, was also able to give the signals at the stated times before totality. The 30-in. and 12-in. coronagraphs were under the charge of Mr. Whitelow, who also made exposures before and after totality with a Zeiss single Protar lens of 14-in. focus, working at *f*/16. This camera was mounted on a tripod with wedge head cut to the latitude of Hernösand. He obtained photographs of the moon projected on the corona 30 seconds and 1 minute after totality. The optical parts of the Littrow spectrograph consisted of a single dense glass prism, 7-in. edge and angle 40°,

a 6-in. lens of 98 in. focal length, and a 6½-in. flat mirror. A Grub cœlostat of 8-in. diameter supplied a beam of light to a 5-in. Alvan Clarke lens of 7 ft. focal length, which formed the sun's image on the slit.

With the assistance of the town electrician, Herr Helenius, leads were run from the electrical plant in the technical school to operate an arc-lamp with iron poles, the pressure being 110 volts and the current 12 amperes. An auxiliary lens and a diagonal prism, which could be pushed backwards and forwards as required, formed the image of the arc on the slit. The slit could be covered with a plate of zinc having a horizontal aperture 1/10-in. in width, so that the comparison spectrum could be placed over the position occupied by the image of the dark moon. Owing to the skill and energy of Mr. Gibbs, the engineer to the party, the instruments were all erected, the cases being utilised as bases, and adjusted,

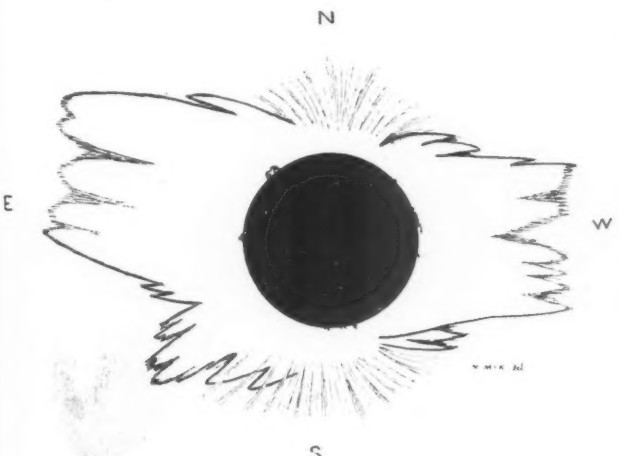

FIG. 2.—Main features of the Solar Corona of 1914, August 21, roughly outlined from photographs taken with the 20-ft. coronagraph at Hernösand.

by Monday, August 17, on which day drills were commenced. We were assisted by students of the technical school under the direction of Mr. Askling, the master of mechanical science. An eclipse clock, designed by Mr. Gibbs, was also erected, a large hand circulating round the dial once in 129 seconds, the computed duration of totality. Its face was lit up by an electric lamp.

The purity of the atmosphere at Hernösand was remarkable, but there was a very considerable amount of cloud on every day, except one, during the days preceding the date of the eclipse. The barometer was high with a persistent north-west wind, accompanied by a variety of types of weather. On the evening, however, of August 20, the wind changed to the south-east, and a beautiful night heralded the perfect weather conditions for the eclipse. The programme settled for me by the Joint Permanent Eclipse Committee was to obtain large scale photographs of the solar corona to show detail, and smaller scale pictures to show the extension. With the spectrograph the coronal spectrum was to be photographed, principally in the red and yellow regions, and if possible a comparison spectrum of the iron-arc was to be placed on the plate.

About half-past eleven on the morning of the eclipse a goodly number of spectators, dressed in their best clothes, assembled in the field near the site of the instruments, and watched the partial phases through dark glasses. In contrast to the demeanour of the spectators in the eclipse expedition to Vinaroz in Spain in August, 1905, they were quite undemonstrative, even when the magnificent sight of the corona in a perfectly dark sky was presented to their gaze. For certainly it was a magnificent spectacle, enhanced by the appearance of the planet Mercury brilliantly shining to the north-west limb of the sun, and Venus near the south-east horizon. To the naked eye the most striking features of the corona were a long fish-tail streamer on the west limb of the sun, and a spreading mass of streamers on the east limb, the salient phenomena being a streamer on the north-east, another shorter streamer south-east, and a long horizontal streamer, less luminous than the other two, placed equatorially. The prominences were not visible to the naked eye; they were seen projected on the slit, and a very fine arched prominence is shown in the north-east quadrant in the photographs. Five large scale photographs were secured with the 20-ft. coronagraph, with exposures of 4, 10, 25, 7, 3 seconds respectively. These show a great amount of detail, including beautiful sheafs of polar rays, prominences, and several crossing and interlacing streamers. The main features are shown in the accompanying outline drawing (Fig. 2), made from some of the negatives by Mr. W. McKeon. With the 30-in. Abney coronagraph, used in so many former eclipses, four photographs were secured, with exposures of 10, 50, 15, and 5 seconds, on plates bathed by Mr. Crowther, of Carlisle, so as to be not solarisable by over-exposure. These show the extension of the corona for fully two solar diameters. With the 12-in. coronagraph, working at $f/3{\cdot}5$, a single exposure was made for 95 seconds, on a Paget "Hydro" non-solarisable plate. This is a beautiful small scale picture, showing, probably, the full extension of the streamers.

With the spectrograph, while I made the exposures, Mr. Gibbs placed the sun's image correctly on the slit, and also took charge of the cœlostat. Several exposures were made at intervals of a few seconds on the tip of the cusps, seven minutes before and five minutes after totality. These mere lines of spectral light have so far not received adequate study. The comparison iron spectrum is on each plate, which

contains, besides, six exposures on the cusp tip. The spectrum of the corona shows very faint continuous spectra between λ4800 and λ6700, with several faint lines on each side of the comparison iron spectrum, and others further removed obviously belonging to the portions of the streamers intersected by the slit. The exposure of the plate was about 95 seconds, and that of the arc spectrum 4 seconds at mid-eclipse. The slit was placed just within the dark limb of the moon on the advancing side. A batch of freshly bathed Panchromatic B plates was kindly forwarded to Hernösand by Messrs. Wratten and Wainwright.

On account of the war the programme for our homecoming had to be considerably modified. The plates were at once developed, and the instruments speedily dismounted, so that we might catch the first possible steamer from Hernösand to Stockholm. From Stockholm we came across land *viâ* Christiania to Bergen, whence we sailed to Newcastle. We had already crossed two Swedish mine fields under the escort of armed vessels, and our passage of the North Sea was no less adventurous and exciting. We were stopped by a British cruiser and warned of the presence of floating mines laid by the Germans directly in our intended course. The lifeboats were got ready, and the course was changed for one to the north of Scotland. A second cruiser pursued us, and, overtaking us, warned us of the danger ahead. Accordingly we came right down the Scotch and English coasts, and finally were convoyed into the mouth of the Tyne by three torpedo-boats.

A. L. CORTIE.

THE BRITISH ASSOCIATION IN QUEENSLAND.

Brisbane, September 4.

THE final session of the Australian meeting of the British Association for the Advancement of Science was held in Brisbane on August 27—September 1. It had been arranged that of the 320 visiting members of the Association, a party of one hundred should visit New Zealand after the close of the Sydney Session, and that the remainder should visit Brisbane, where the final official business would be transacted. Unfortunately the state of war in which Australasia in common with the rest of the Empire is involved, interfered somewhat with this arrangement. The cancellation of the New Zealand meeting caused a number of those, who would otherwise have gone to the Dominion, to express a desire to visit Brisbane instead. At the same time the utilisation of the R.M.S. *Orvieto* as a transport caused a number of people who had intended returning to England in her to shorten their visit to Australia.

As a consequence of these changes in *personnel* of the party which came to Brisbane the local

Photo.] [*Topical Press Agency.*

FIG. 1.—An excursion party of the British Association at a wood-chopping contest in the Australian bush.

arrangements suffered disorganisation to such an extent that the plans which had been formed had to be modified greatly, and fresh arrangements made in the four days immediately preceding the meeting.

The Brisbane party left Sydney on Wednesday, August 26, in two special sleeping trains. The visitors arrived at Wallangarra on the Queensland border in time for breakfast, at which and also at lunch they were the guests of the Queensland Government. At Wallangarra a change of gauge occurs, the New South Wales gauge of 4 ft. 8½ in. being left behind, and the narrow gauge of 3 ft. 6 in., which is common to all the Queensland railways, being reached. The party travelled from Wallangarra in two special trains, arriving at Toowoomba in time for luncheon and reaching Brisbane about 6 p.m.

The arrangements which had been made for the conveyance of the visitors to the homes of their guests worked very satisfactorily, and within eight minutes of the arrival of the trains the last of the visitors had left the station.

The reception room and post office were situated at the temporary university building, but unfortunately it was not possible to arrange for the lectures and addresses to be delivered there on account of the absence of any hall or lecture-room large enough to accommodate the audiences which were anticipated.

Two addresses were delivered on Friday morning in the Albert Hall. The first, which was officially described as the second part of the presidential address in Section M (Agriculture), was given by Mr. A. D. Hall, who chose as his subject "Tropical Agriculture." The hall was well filled with a large and appreciative audience; the local members were particularly interested in the subject, and it is hoped that the address will prove helpful in many ways.

It had been originally planned that the second address should be the second part of the presidential address in Section I (Physiology) on the subject of "Tropical Diseases," and on account of the peculiar local and climatic interest of the subject chosen much disappointment was felt in Brisbane at its unavoidable abandonment. In place of this Prof. E. W. Brown, of Yale, delivered an address on cosmical physics.

Two public lectures or discourses were arranged for Friday evening. Prof. Armstrong lectured to an interested audience in the Centennial Hall on the "Materials of Life." In his lecture he traced the building up of the simple compounds of carbon, hydrogen, oxygen, and nitrogen into the complicated compounds which are synthesised in the plant organism; also the breaking down of these under enzyme and other action during the process of digestion and the building up again from these relatively simple substances of the highly complicated products which are prepared in the animal organism. A vote of thanks was proposed by Prof. Steele, of Brisbane, and the subject was discussed by Prof. Bateson, who occupied the chair. The second lecture was held in the Albert Hall on the same evening. Sir Oliver Lodge occupied the chair, and Prof. Howe gave an interesting discourse on wireless telegraphy.

The meeting closed on Monday evening, when Sir Edward Schäfer gave a discourse on the subject "Australia and the British Association." At the conclusion of the lecture Sir Arthur Morgan, Lieutenant Governor of the State of Queensland, proposed a vote of thanks to the lecturer.

A citizens' lecture on decorative art in Papua was delivered by Dr. Haddon to a large audience in the Exhibition building, the Mayor of Brisbane, Alderman C. Jenkinson, occupying the chair. There were two garden parties given in honour of the visitors, one on Friday afternoon in Bowen Park by the Mayor of Brisbane, and another on Monday afternoon in the university grounds by the Government of Queensland, the Lieutenant Governor receiving the guests on behalf of the Government.

Photo.] [*Topical Press Agency.*

FIG. 2.—An excursion party of the British Association in the Australian bush.

The Senate of the University entertained the general officers of the Association, the presidents and ex-presidents of sections, and the foreign visitors at luncheon on Friday, August 28. The vice-chancellor, Mr. R. H. Roe, was in the chair, and proposed the health of the guests. This was replied to by the president, Prof. Bateson, in a

speech extremely inspiring and helpful to our young University.

The week-end was devoted to excursions, and amongst other places visited were the mines at Gympie and at Mount Morgan, the sugar and fruit-growing districts of Nambour and Cleveland, and the Prickly Pear infested country of the middle West, and the Prickly Pear experimental station at Dulacca. The officer in charge of this station is Dr. Jean White, who at present has more than 2000 experimental plots under investigation, and the object of whose work is to ascertain the best means of exterminating the pest.

After the close of the Brisbane session, the party separated, some returning to Europe by way of America, others through Java and India, and a large number of the party travelled by the mail route through the Suez Canal.

[One of the week-end excursions during the visit of the British Association to Melbourne, referred to in an article in our issue of October 8, was to the Warburton district, where the giant ferns and gum-trees, rising in some cases to a height of about three hundred feet, gave the visitors impressive views of Australian bush scenery. The two photographs here reproduced show the party watching a wood-chopping contest, and in one of the gullies of the forest rich in objects of botanical interest.]

NOTES.

THE Harveian oration on advances in knowledge regarding the circulation and attributes of the blood since Harvey's time, was delivered at the Royal College of Physicians on Monday, October 19, by Sir Douglas Powell. After the oration Sir Ronald Ross was presented with the Bissett Hawkins Memorial Medal for distinguished services in the advancement of sanitary science and public health.

THE question of the continuance of meetings of scientific societies during the war, raised by Dr. W. T. Calman in a letter which appears elsewhere in this issue, is one which each society must decide for itself after taking into consideration the papers likely to be forthcoming, and the number of fellows or members likely to attend meetings at which they are presented. It is to be hoped, however, that if meetings go on as hitherto, any German or Austrian members of the societies will absent themselves for the time being, as objection might be taken to their presence under existing conditions.

MANY leading men of science in the British Isles, as well as distinguished representatives of other branches of learning, have signed a statement which has just been issued in reply to manifestoes published by various university professors in Germany. The statement refers to the policy of national aggrandisement based on the threat of war advocated by von Treitschke, von Bülow, von Bernhardi, and strongly supported by public opinion in Germany; and it summarises the diplomatic papers in which the events are described that forced Great Britain into the present war if she wished to preserve an honourable position among nations. The concluding paragraph is as follows:—"The German professors appear to think that Germany has in this matter some considerable body of sympathisers in the universities of Great Britain. They are gravely mistaken. Never within our lifetime has this country been so united on any great political issue. We ourselves have a real and deep admiration for German scholarship and science. We have many ties with Germany, ties of comradeship, of respect, and of affection. We grieve profoundly that, under the baleful influence of a military system and its lawless dreams of conquest, she whom we once honoured now stands revealed as the common enemy of Europe and of all peoples which respect the Law of Nations. We must carry on the war on which we have entered. For us, as for Belgium, it is a war of defence, waged for liberty and peace."

THE Royal Photographic Society has just opened to the public a house exhibition of photographs by Mr. Lewis Balfour, "Bird Life on the Bass Rock." There are upwards of one hundred of these pictures showing the various sea birds and incidents in their lives. The public will be admitted free, daily from 11 a.m. to 5 p.m., until November 28.

THE second Thomas Hawksley lecture will be delivered in the meeting hall of the Institution of Mechanical Engineers on Friday evening, October 30, by Mr. W. B. Bryan, the subject being "Pumping and other Machinery for Waterworks and Drainage." The Thomas Hawksley fund was founded by Mr. Charles Hawksley to perpetuate the memory of his father who was president of the Institution of Civil Engineers in 1871 and 1872, and president of the Institution of Mechanical Engineers in 1876 and 1877. The income of the fund is devoted to the maintenance of a lecture and to the award by the council of the Institution of Mechanical Engineers annually a "Thomas Hawksley" gold medal, with or without a premium, in money, books, or otherwise for the best original paper read at a general meeting of the institution or printed in its proceedings.

PROF. DAVID TODD, who passed through London a few days ago on his return to the United States from Russia, where he observed the total solar eclipse of August 21, as will be described in a later issue, brought with him a very successful kinematograph film of the eclipse, and by the courtesy of Messrs. Pathé Frères it was projected upon the screen of their theatre in Charing Cross Road. The film reproduced the solar corona with the narrow crescents before and after it with great fidelity. It was taken by Dr. N. V. E. Nordenmark, of Stockholm, at Sollefteå, Sweden, latitude N. 63° 12′, longitude 45′ west of Stockholm, where the sky was absolutely free from cloud. The lens was a 50 mm. Zeiss of 305 mm. focus, and the exposures were about six to the second. In all there are more than seven hundred excellent pictures of the corona, which is well seen even into the partial phase.

THE death of Dr. Anthony Traill, provost of Trinity College, Dublin (writes E. P. C.), removes a forceful personality from Irish life. Of striking all-round ability, never brilliant, but possessing an indefatigable power of work, he outdistanced many of his colleagues who, from the academic point of view, were more highly endowed. Taking his LL.D. at twenty-six, he obtained fellowship next year, 1865, and shortly afterwards he entered the medical school, taking his M.D. in 1874. In 1899 he was co-opted a senior fellow, and was appointed provost in 1904, *vice* Salmon. If he was wanting in some qualities usually looked for in a provost, he possessed, and in a high degree, others not so often found in academic men, and thus he was able to bring the college safely through the extraordinarily critical times of the Parliamentary settlement of the Irish University question, and the, in some ways more delicate one, of internal reform. For this reason, and the untiring energy with which he strove to widen its activities, he deserves the hearty gratitude of the college, and must be ranked as one of its most efficient provosts. Of the man himself, it is difficult to give an idea in a few lines. His interests were exceedingly wide. As an athlete, an alpine climber, a good cricketer, a rifle shot, as a college fellow and tutor, as a member of public boards and commissions, as a financial adviser to the Church of Ireland, he always acted up to the maxim, "Whatsoever thy hand findeth to do, do it with thy might." Up to his seventy-fourth year he was remarkable for bodily vigour, even then shooting over his bogs for an entire day without a sign of fatigue; and what must be regarded as his premature death at seventy-six was due to his almost contemptuous disregard of painful symptoms to which far younger men would have yielded. He was seen at his best as a most kindly and entertaining host in the family home at Ballylough.

OWING to the absorbing attention given by our newspaper Press to the war, we receive but the scantiest notices of important earthquakes, even when they occur in our own Colonies. From the *Morning Post* for October 15, we learn that, at 2.15 a.m. on the day before, an earthquake was felt all over the colony of Jamaica, strong enough to awaken the inhabitants, but not to cause any damage to buildings.

ON October 17, at about 8 a.m., the whole of Greece was shaken by violent earthquake shocks, the first of which lasted twenty seconds. The centre was apparently near Thebes, where a number of houses fell, especially in the villages of Cappareni and Pirri, which were partially destroyed. Atalante and Chalcis were also seriously injured, and all the railway stations on the Larissa line were damaged. The shocks were also felt in the Peloponnesus, the Cyclades, Euboea, and the Ionian Islands. Several houses at Athens and the Piraeus were cracked, but none of the ancient monuments suffered. A few persons were injured, but, so far as known, no lives were lost. Though much less severe than the earthquakes of April 20 and 27, 1894, the recent shock seems to have originated in the same region, and probably in the same great fault. This fault was traced by M. Papavasiliou for a distance of thirty-three miles, passing through Atalante, in a direction parallel to the adjacent Gulf of Euboea. The throw was generally small, though in places it amounted to as much as 4 or 5 ft. (see NATURE, vol. l., p. 607).

THE *Philippine Journal of Science* for April last supplies an interesting account by Mr. E. B. Christie of the pottery industry at San Nicolas, in the Ilocos Norte province. A modified form of the potter's wheel is used, the clay being shaped into a short, thick cylinder, and laid on a board which rests upon a second board, but not connected with it by a bearing-pin. From time to time the woman worker gives the upper board a turn with one hand while she works the clay with the other. At first she uses only her fingers to shape the vessel. Later on she holds a smooth stone against the inner surface of the vessel with her left hand while with the other she works a paddle to form the outer surface. With the paddle she beats the clay, causing it to spread. When the vessel is complete, she smooths the outside with a shell and smears it with red earth mixed with water in order to produce a uniform colour. If she does not do this, the clay assumes a weak, irregular colour when it is fired. If she desires to blacken the pot, it is, while still very hot, covered with rice bran. This becomes imperfectly consumed, and leaves a black deposit on the clay. The industry is purely domestic, but it is of some economical importance.

IN the October number of *Man* Dr. H. Basedow furnishes an obituary notice of Mary Seymour, the last relic of the lost Tasmanian race. Born in 1833, she died in 1913, her mother being a full-blooded Tasmanian aboriginal, who married a whaler named Nat Thomas. On her marriage to Joseph Seymour, Mary for the first time learned a little English, and she claimed to be the first woman born on Kangaroo Island. She used to give graphic accounts of her experiences in the pioneering days of South Australia. She was of short but robust stature, and her features indicated a keen intellect combined with a determined will. Seen in profile, the deep notch below the glabella at the root of the nasal bones betrayed a Tasmanoid inheritance, described by Dr. Garson (Journal Anthropological Institute, vol. xxvii., plate 27) as one of the characteristics of the race. The hair was silken, white, and wavy, the eyebrows bushy. Her lips and skin were remarkably free from hair, and her skin was of a dark bronze-brown and wrinkled with age. The lower jaw was well developed, and had a big loose flap of skin attached to it that produced a very noticeable double-chin. The keen, small eyes lay deep within their sockets; their colour was a greyish-brown. It is interesting to compare the photographs accompanying the article with those published by Mr. H. Ling Roth in his classical memoir descriptive of this interesting race.

THE preventive treatment of fowl cholera is dealt with by Mr. Philip B. Hadley in Bulletin 159, Agricultural Experiment Station of the Rhode Island State College, U.S.A. Various avirulent cultures of the

fowl cholera micro-organism were found to be protective to rabbits against certain virulent strains of the organism, either singly or in combination. Attempts are now being made to produce a corresponding protection among poultry, for fowl cholera is a disease which frequently causes considerable loss to the poultry farmer.

IN the report of the Leyden Museum of Natural History for the year ending September 1, 1914, Dr. E. D. Van Oort, the director, pays a well-deserved tribute to the work of his predecessor, the late Dr. Jentink. The additions to the collection were numerous, and the number of visitors during the year 3134.

RECRUITS of the Transport Corps are receiving instruction from their officers in the north hall of the British Museum (Natural History) on the external characters and osteology of the horse. For this purpose a mounted skin and a skeleton of the horse have been removed from their cases and placed on the floor of the hall, from which the general public are excluded during the periods of instruction. We understand that the officers of the Veterinary Department, aided by the Transport Corps, have succeeded in rendering a large number of wounded or otherwise injured horses at the front fit for further service; such horses include many taken from the Germans.

IN an editorial article on eugenics and war in the October issue of the *Eugenics Review*, it is pointed out that "the British Empire, by reason of maintaining her army on a voluntary basis, must inevitably suffer racially more than other nations. The battle death-rate must strike her unevenly and reduce the number of her males amongst the class from whom it is most desirable that she should produce the stock of the future. In the countries with universal compulsory service, the reduction in effective males will be spread over the entire population; good and bad will alike be reduced. In this country the types which are physically and mentally superior will volunteer for active service. . . . The sample of those killed will not be the average of the race, but the best type of the race. . . . Although the system may give victory and national prestige, the racial effect must be injurious."

THE contents of Nos. 3 and 4 (issued in a single cover) of vol. xxxvi. of *Notes from the Leyden Museum* consist exclusively of papers on invertebrates, the longest of which is a continuation of Dr. R. Van Eecke's "Fauna Simalurensis," dealing with Indo-Australian Lepidoptera. Dr. J. H. Vernhout also contributes a further instalment of the results of his study of the land and fresh-water molluscs of the Dutch American colonies, discussing in this instance those of Curaçao. It would be natural to expect that the land-snails of the Curaçao group of islands should exhibit a close affinity with those of Venezuela; as a matter of fact, this is far from being the case, only seven out of twenty-five species recorded from the three islands being common to the mainland. Nor is this all, for many even of the genera are quite unknown on the South American continent, but are more nearly related to or identical with Central American and Jamaican types.

IN these columns (October 2, 1913) reference was made to the regional survey undertaken by the Croydon Natural History and Scientific Society. In the 1913–14 volume of the society's Proceedings and Transactions, which we have received, an account of the general progress of this survey is given in the form of a report by the survey committee. The scheme has aroused much interest, both within and outside the society, has caused the revival of the photographic section, and increased activity in the botanical, zoological, and archæological sections, and has brought about closer co-operation between all the sections of the society. Mr. C. C. Fagg, secretary of the regional survey committee, contributes an introductory paper on the mineral and agricultural industries of the survey area, dealing with these from the geographical point of view, with plates and a geological (drift) map of the Croydon area.

WE have received the report of the Botanical Survey of India for the year 1913–14, in which the officiating director of the survey, Mr. C. C. Calder, summarises the extensive and valuable work done during this period. Under the heading of systematic work, references are made to the results, published in the records of the survey and in other journals, of the field investigations made by members of the survey staff and others, and it is interesting to note that in many cases these results include not only lists of species collected, but studies of the vegetation in various aspects, the distribution of the species being correlated with the adaptations of the plants to their environment and their aggregation into plant communities. This ecological side of field work in botany has not hitherto figured largely in Indian botanical publications, but as the systematic survey proceeds it will doubtless be accompanied by further and more intensive distributional and ecological study. The chemical part of the work hitherto undertaken at the Indian Museum, Calcutta, has now been transferred to other departments, while the newly appointed economic botanist to the survey, Dr. H. G. Carter, has begun the collection of materials necessary for the compilation of the work on Indian plants of economic importance urged by the Royal Society some years ago. There is also in active preparation an index to all species of Indian plants not included in Hooker's "Flora of India"; this index already contains nearly 900 species, and will be published as a single number of the records of the survey.

THE report for the past year of the New Zealand Department of Scenery Preservation states that 3000 acres were reserved, bringing the total area of scenic reserves in the Dominion to 214,000 acres, comprised in 363 different reserves. It is pointed out that the great bulk of this land is unsuitable for settlement, while it assists to conserve water, protect soil, and prevent denudation. Private residents have shown remarkable munificence in presenting areas to the

Government. The Scenery Preservation Act of 1903, consolidated in the Act of 1908, provided a total sum of 100,000*l*. Each year a portion of this is authorised for expenditure; a balance now remains of 27,136*l*. It is curious that the native Maoris are the only section of the population that does not approve of the movement. Among details of interest the following may be cited. Deer are extremely detrimental to forest. The lakes of New Zealand have been formed by the erosive action of huge bodies of ice or by volcanic action; but Waikaremoana was formed by an immense fault in the stratification of the country. The greater part of forest is beech, with its two varieties of black and red (*Nothofagus solanderi* and *fusca*). Native flowers and birds are well looked after in these reserves, and the National Society for the Protection and Preservation of New Zealand Forests and Bird Life has just been formed. "Each member of the society should consider himself an unofficial ranger." It is noteworthy that most of these reserves coincide with health resorts and sporting centres. Perhaps the most beautiful of them all is Day's Bay, only forty minutes from Wellington, and a favourite excursion. This bit of forest is as it was 1000 years ago. Another gem is the reserve on the Waganui river, which is "the finest sight of its kind in the whole world." "It is no compliment," said a Russian traveller who had seen the great rivers of the world, "to call the Wanganui 'the New Zealand Rhine.'"

IN Publication No. 4 of the Meteorological Institute of Chile Dr. W. Knoche gives a very interesting discussion of the hourly observations specially made at Mataveri, Easter Island, for one year ended April, 1912. From a meteorological point of view the position of the island is important for the study of atmospherical circulation; it lies in the south-east Pacific Ocean (approximately 27° 10′ S., 109° 26′ W.) in one of the permanent areas of high barometric pressure, and within the limit of the trade-winds, especially in summer. Notwithstanding the uniformity of the climate, one year is naturally too short a period to deal with satisfactorily, and we are glad to see that Dr. Knoche has been able to make arrangements for observations to be continued, although on a smaller scale. The mean barometric pressure (M.S.L.) was: January, 30·08 in., July, 30·06 in., year, 30·06 in.; but conditions are said to differ considerably in different years, probably owing to the shifting of large masses of air in the high-pressure area. Rainfall during the summer half-year amounted to 22·2 in., and in other months to 27·9 in. The mean of the hottest month was 74·8° in February, and of the coldest 64·2° in October. The absolute extremes were 87·8° in February, and 51·1° in July. An unpleasant feature of the island is that it is infested by large swarms of mosquitoes. The volume is well illustrated by curves and diagrams.

THE Journal of the Washington Academy of Sciences for September 19 contains a short account of the results obtained by Messrs. G. K. Burgess and J. N. Kellberg, of the Bureau of Standards, during an accurate investigation of the changes of the electrical resistance of pure iron wire up to a temperature of 1000° C. A platinum and an iron wire of about an ohm resistance were wound on porcelain insulators in an evacuated quartz tube, heated in an electric furnace. The resistance of each wire was determined by the bridge method with an accuracy of 0·00001 ohm, during the slow heating and cooling of the furnace. That of the platinum wire served to determine the temperature of the iron wire. The resistance of pure iron on heating was found to increase at a rate which itself increases up to 757° C., the temperature at which the iron ceases to be ferromagnetic. Above that temperature the rate of increase again decreases, so that at 895° C. the resistance reaches a maximum, and at 906° C. a minimum beyond which it appears to increase regularly. On cooling the minimum occurs at 880° C., the maximum at 870° C., and the change in the rate of decrease again at 757° C. The authors attribute the non-reversible change at the higher temperatures to recrystallisation, but they have not been able to detect any crystalline change at the 757° C. point.

THE forthcoming books of the *Cambridge University Press* include:—A Theory of Time and Space, by A. A. Robb; The Surface of the Earth: Elementary, Physical, and Economic Geography, by H. Pickles; The House-Fly, by Dr. C. Gordon Hewitt (in the Cambridge Zoological Series); A Book of Simple Gardening, by D. Lowe; and (for the University of Chicago Press) Water Reptiles of the Past and Present, by S. W. Williston; and Assyrian and Babylonian Letters, edited by R. F. Harper, vol. xiv.; and *Mr. John Murray* announces:—A Hunter-Naturalist in the Brazilian Wilderness, by Theodore Roosevelt, illustrated; Emma Darwin: a Century of Family Letters, 1792–1896, edited by H. Litchfield, two vols., illustrated (the second volume of the work will contain many unpublished letters of Charles Darwin, supplementing his biography by giving some idea of the more intimate side of his life); Concerning Animals and other Matters, by E. H. Aitken ("EHA"), with a Memoir of the author by Surgeon-General W. B. Bannerman, illustrated; A History of the Gold Coast and Ashanti, from the Earliest Times to the Beginning of the Twentieth Century, by W. W. Claridge, two vols.; a new and enlarged edition of The Rudiments of Practical Mathematics, by A. Constердine and A. Barnes.

MANY rare and valuable books and papers relating to mathematical, physical, and natural sciences, and to technology, are included in a catalogue, "Bibliotheca Chemico-Mathematica," part x., just received from Messrs. Henry Sotheran and Co., 140 Strand, W.C., and 43 Piccadilly, W. The catalogue contains descriptive notes upon a large number of the books and authors, and should be of assistance to bibliophiles in search of important scientific works. We notice particularly books by, and on, Pasteur, Paracelsus, Priestley, Réaumur, Regiomontanus, Respighi, and many other authors, both ancient and modern.

OUR ASTRONOMICAL COLUMN.

COMET 1913*f* (DELAVAN).—Delavan's comet is now a more prominent object in the evening sky, and can be picked up by anybody without an ephemeris: it has a tail of considerable length and brightness. The comet is rapidly moving in declination covering about 3° in four days. It is also visible as a morning object. The comet passes perihelion on October 26, and in the meantime should become brighter. The following is a continuation of Prof. Biesbroeck's ephemeris up to the end of the present month:—

	R.A.	Dec.
	h. m. s.	° ′
Oct. 22 ...	13 56 0 ...	+29 33
26 ...	14 12 0 ...	26 27
30 ...	14 26 36 ...	23 25

We are indebted to Prof. David Todd for a print, here reproduced, of a photograph of the comet taken

Delavan's Comet, September, 1914. Photographed at Stockholm Observatory. Exposure, one hour.

last month by Dr. Karl Bohlin at the Stockholm Observatory.

ENCKE'S COMET.—The October number of the *Observatory* publishes the elements and ephemeris of Encke's comet as computed by M. L. Matkewitsch, of Pulkova. The latter for the present month are as follows:—

	R.A.	Dec.
	h. m. s.	° ′ s.
Oct. 20 ...	8 29 44 ...	+61 37
22 ...	9 26 3 ...	60 28
24 ...	10 20 21 ...	57 42
26 ...	11 7 51 ...	53 27
28 ...	11 46 43 ...	48 7
30 ...	12 17 33 ...	+42 10

The corrections to this ephemeris on about October 27 are given as R.A. +8s., declination −6′. It is stated that the comet will be nearest the earth on October 27, and is generally a fairly conspicuous object when perihelion occurs in winter. It has sometimes been glimpsed with the naked eye.

THE RECENT ECLIPSE EXPEDITIONS.—Further news is to hand regarding the experiences of some of the recent eclipse expeditions (the *Observatory*, October). The party from the Solar Physics Observatory, Cambridge, seems to have had particularly bad luck, for not only did a thick detached cloud completely hide the whole of the total phase, but even the telegrams announcing the complete failure of the observations never reached home. Prof. Newall, who writes this account, draws the moral of "the importance of spreading the camps of observing parties even in the restricted area chosen for a station of observation." Prof. Perrine set up his instruments in the same camp as the Cambridge party, and suffered a similar fate. While this camp was about four kilometres from Theodosia, on a site one kilometre nearer Theodosia, MM. Beljawsky and Neujmin obtained observations for about 30 seconds. At Theodosia the eclipse was seen in blue sky between patches of cloud, and observations were made during the whole total phase. Among the observers there were Signor Ricco, Count de la Pluvinel, Dr. Donitch, Prof. Sternberg (Moscow), M. Crétien (Nice), and M. Ascarza (Madrid). Dr. Backlund's expedition to Riga met with success, and Prof. Newall refers to "the beautiful photographs of the corona" secured by M. Kostinsky, who was of that party. Prof. Campbell and his party, who observed at Kiev, had adverse weather conditions.

An interesting account of the Greenwich Eclipse Expedition is given by Mr. H. S. Jones, one of the official observers. This party, at Minsk (Russia), had a narrow escape, for "when totality commenced a long cloud was approaching the sun, but fortunately did not reach it until the last second of totality." The whole programme was thus carried out. The corona he describes as "comparatively bright, and of a steely-blue whiteness, with no trace of yellow—it was of the intermediate type, with four streamers, resembling somewhat the 1898 corona."

SOCIETÀ DEGLI SPETTROSCOPISTI ITALIANI.—The July and August numbers of the *Memorie della Società degli Spettroscopisti Italiani* contain numerous contributions of interest on various subjects. In the July number the variable R. Leporis is dealt with by E. Padova, who publishes some new observations and a calculation of the period, which he gives as 438·93 days. This is Hind's famous crimson star, which in 1845 was described by him as "of the most intense crimson, resembling a blood-drop on the background of the sky. . . ." Some new observations and a discussion of them relating to the variable ST Ursæ Majoris are communicated by G. Silva. A preliminary note by E. Paci describes the observations made for the determination of the latitude of the centre of the cupola of the Etna Observatory. The observations were secured during 1913 by the Horrebow-Talcott method, and the value derived was +37° 44′ 8·392″. The last-mentioned author contributes two papers to the August issue, the first dealing with a study of the Ertel meridian circle of the Catania Observatory, and the second with the difference of longitude between Catania and Palermo as determined by telegraph by Ricco and Zona in 1894. After giving the details of the observations, he derives the value 6m. 54·7826s. ± 0·0055, as being the difference of longitude between the two observatories. This number concludes with the obituary notices and portraits of Giuseppe Lorenzoni and Edward S. Holden, written by A. Antoniazzi and W. W. Campbell respectively.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE Australian meeting of 1914 will always occupy a prominent place in the annals of the British Association, if only on account of the interest attaching to the proceedings of its Anthropological Section. Not only did the representatives of this rapidly developing branch of science muster in full strength, but their

discussions, bearing as they did largely on Australian problems which are concerned with the most primitive of existing human types, were throughout directed to fundamentals. Needless to say, the shadow of the great war raging in Europe cast a chill over the spirits of all concerned, and it needed a certain moral effort to carry through a programme in which, at least as originally designed, business and pleasure claimed equal shares. As it was, the inclination of the balance towards the side of seriousness was not without its advantage for those students who found the allotted time all too short to enable them to cope with Australia's magnificent ethnological collections. These must be seen before one is in a position to assign to Australian culture its true place in the evolutionary scale.

In Western Australia certain anthropologists of the advance party got into touch with aboriginals, and again in South Australia Prof. Stirling organised a most successful expedition of the whole section to Milang, where a large group of the Narrinyeri tribe were on view, so that everyone was presently hard at work, spurred on by the discovery that, even if degeneration has gone far, there still exists plenty of valuable lore to be garnered. It must be added that in the Adelaide Museum Prof. Stirling has amassed wealth untold in the way of ethnological material, special value attaching to the spoils from the central deserts, illustrative as they are of the life of the now famous Arunta and their congeners. At Adelaide, too, Prof. Sollas gave an evening lecture on prehistoric man, which delighted his large audience.

Formal proceedings opened at Melbourne on Friday, August 14, Prof. G. Elliot Smith leading off with a remarkable comparison of certain customs and inventions of the ancient Egyptians with those of primitive peoples of the Far East, the full development of his argument being unfortunately somewhat hampered by want of time. After Dr. A. Low had described the finding of certain curious cists of the Bronze age in the north-east of Scotland, the section adjourned to the museum. Here, first of all, Messrs. A. S. Kenyon and D. J. Mahony exhibited and explained a very rich series of aboriginal stone implements, extending from the well-polished adze at one end of the scale to the roughest Palæolithic and even Eolithic types at the other. Then Prof. Baldwin Spencer showed all manner of specimens of native handiwork, including a remarkable series of drawings on bark from the Alligator River, Northern Territory.

On Tuesday, August 18, Mr. Balfour gave forth the results of his investigations into the remains of an early Stone age in South Africa. He was followed by Dr. Marett, who, as chairman of the committee that has undertaken the recent excavation of a Mousterian cave habitation in Jersey, was able to report a rich harvest of discoveries. Prof. G. Elliot Smith and Prof. J. Symington then engaged in a discussion, scarcely less impassioned than it was profound, concerning the possibility of deducing the shape of the human brain from that of the inner surface of the cranial wall, with special reference to the primitive characters that have been attributed on these grounds to the Piltdown skull. Major A. J. N. Tremearne, who was returning next day to Europe on military duty, wound up the morning with a well-illustrated account of the Bori, or disease-spirit, ceremonies of certain Hausa colonies in North Africa. In the afternoon Prof. Felix von Luschan, of Berlin, delighted a large audience with a discourse dealing with the question, "Are we degenerate?" and embodying various more or less startling proposals of a practical nature in the interest of eugenics.

On Wednesday, August 19, the whole morning was devoted to a debate, initiated by Dr. Rivers, on the subject, "Is Australian Culture Simple or Complex?" The section listened with the greatest interest to Dr. Graebner, who holds strong views on this particular topic, and the ball was kept rolling by Prof. Sollas, Prof. Berry, Prof. von Luschan, Prof. Haddon, Rev. J. Mathew, Mr. Balfour, Mr. A. R. Brown, Dr. Malinowski, Dr. Marett, and others. The discussion as a whole was most profitable, though perhaps it raised more problems than it solved. It remains to add, in reference to proceedings in Victoria, that, besides enjoying unlimited facilities for study at the museum, and in Prof. Berry's well-equipped department of anatomy, the anthropologists had the opportunity of visiting an aboriginal quarry at Fisherman's Bend, near Melbourne, and, again, of making further acquaintance with aboriginals, since the Colanderrk station near Healesville provides types from several parts of the continent, the older members of the native community preserving considerable traces of their former culture, as witness their corrobborree songs which Prof. von Luschan was careful to record by means of the phonograph.

Arrived at Sydney, the section on Friday, August 21, was treated by Sir Everard im Thurn to a presidential address which summed up in telling fashion his impressions of the character of the so-called "savage" in the shape of the primitive Fijian. He emphasised "the enormous, scarcely conceivable difference in habit of thought which separates the savage from the civilised man," and showed on the strength of his experience as an administrator that the process of mutual adjustment, so far as it is possible at all, must necessarily be slow, demanding, too, on our part much patience, good will, and anthropological science. Dr. Ashby followed with an account of various archæological discoveries of his own at Malta. Then a most sensational announcement was "sprung" on the meeting. It appears that, just about the time that the pioneers of the British Association were setting foot on Australian soil, a highly petrified skull was found on the Darling Downs, Queensland, such as may very well prove to be assignable to Pleistocene times, Pleistocene man in Australia having hitherto existed only in the sphere of pure hypothesis. Profs. David and Wilson, who exhibited the specimen to the much-moved section, were careful to state the case for the attribution of a high antiquity to the specimen with the greatest caution, the chief argument, pending a full study of the anatomical characters, resting on the fact that the state of petrification which the skull displays corresponds closely to that observable in regard to the remains of Diprotodon and other extinct animals from the same district. The Rev. Dr George Brown then read extracts from an interesting paper on Samoan folk-lore, which he has offered to *Folk-Lore* for publication.

On Tuesday, August 25, the morning session opened with a discussion, led by Dr. Haddon, on the importance of the study of anthropology for the administrator. The president lent the weight of his great authority to the plea for a more thorough instruction of those who are set over natives in the mental habits and culture of their charges, and something was said by other speakers of what is being done by some of the British universities to provide an education in anthropology, both theoretical and applied. Dr. Rivers next spoke of gerontocracy in its bearing on marriage in Australia, showing how the old men's tendency to appropriate all available wives has in certain cases left its mark on the permanent structure of society. Mr. A. R. Brown followed with an account of the varieties of totemism in Australia, his classification covering several new types recently discovered by himself in Northern Territory, or by Mrs. Bates in the Eucla district. In the afternoon the section repaired to the

museum, where local experts provided a full programme. Mr. R. Etheridge commented on various ethnological exhibits from Australia and New Guinea, being part of the rich collection over which he presides. Mr. S. A. Smith dealt with various anatomical peculiarities of the Australian aborigines. Messrs. Flashman, Hedley, Enright, and Elmore were also to thank for interesting contributions and exhibits, while a great debt is due to Prof. J. T. Wilson, who, despite the severe duties of military censor, managed to arrange for so strongly supported and well-organised a sectional meeting as that of the anthropologists at Sydney.

It has proved quite impossible to do justice here to the multitudinous experiences which, altogether apart from the formal proceedings of the section, have served to make the Australian visit of the association, and of the anthropologists in particular, at once pleasant and profitable in a quite unique way. The unfailing kindness and hospitality shown by our overseas brethren one and all make it a too invidious task to assign special thanks, and it must suffice, by way of showing due gratitude, to see to it that, in the way of science, Australia's myriad wonders and excellences are henceforth rated at their proper worth. As for the anthropologists in particular, they cannot be accused of having neglected Australia, since it has ever been the happy hunting-ground of the theorist seeking to reconstitute the life of primitive man; but at any rate it is likely that henceforth the study of Australian problems will proceed more intensively, inasmuch as the astonishing wealth of the Australian museums has been realised from near at hand. Moreover, we come away feeling that we have left on the spot plenty of men capable of carrying out the best kind of anthropological work, if only those in control of ways and means can be induced to make proper provision for a branch of study in which Australia might well aspire to lead the world.

THE IRON AND STEEL INSTITUTE.

ONE of the most noteworthy of the papers which was to have been presented at the Paris meeting, abandoned on account of the war, describes a new method of heating blast-furnace stoves. It appears from experiments on a stove carried out at the Neunkirchen works of Messrs. Stumm Brothers that, in their ordinary practice, of the total heat put into the stove about 26 per cent. was carried away in the waste gases and 18 per cent. was lost by radiation. Accordingly the efficiency of the stove was not more than 56 per cent.

As the author, Dr. Spannagel, points out, it is almost the universal practice to heat the stove for three to five hours and then send the blast through for one to one and a half hours. Messrs. Pfoser and Strack set themselves the task of finding out why the chequer work gives up its heat to the blast in a so much shorter time than is required to collect the heat from the waste gases, and they found that it was due to the fact that the velocity of the gases is different in the two cases. Under present conditions, when the temperature of the stoves is required to be raised the velocity of the gas is increased, and this causes the temperature of the waste gas to rise. Hence the waste gas losses are increased and the efficiency is reduced. The experimenters found, however, that this rule only holds up to a certain point, and that if the velocity is increased still further the temperature of the waste gas not only ceases to rise but begins to fall. The reason for this is probably that with a low velocity gas the molecules flow almost parallel to each other and the friction with the bricks is inconsiderable and consequently it is only the molecules which flow close to the chequer brick which transmit their heat by direct contact, whereas the remainder impart their heat slowly by radiation. If now the velocity is increased to the usual extent, the friction of the gas molecules against the brick causes some eddying in the outer layer of gas, and the inner particles are partly drawn into movement. The heat transmission is more rapid, but since the gas velocity is greater more heat is carried off unused. By raising the velocities still more the friction between the gas molecules and the brick becomes so great that the particles rebound and impart their rapid movement to those even in the centre of the current. Accordingly, the violent eddying produced brings all the molecules rapidly in contact with the chequer brick, and they give up their heat rapidly. Hence the temperature of the waste gas falls. The principle of the method, therefore, is precisely the same as that of the high-speed boiler designed by the late Prof. Nicholson, and indeed the authors say, "Experiments which have already been made in boiler firing have given particularly favourable results."

In heating the stoves the velocity of the gas is brought up to the necessary point by blowing in compressed air at a pressure of about 16 in. of water. At the first trial the heating period was reduced to 1½ hours, "the temperatures of the waste gases and of the blast being 350° C. maximum, and 800° C. respectively, as compared with the former heating period of 4½ to 5 hours, and a waste gas temperature of about 700° C. maximum, the blast temperature being the same." The experimenters have found it advantageous to use highly cleaned gas, since it enables the cross section of the heating passages to be reduced and the surface of the chequer brick to be substantially increased.

One of the outstanding problems, both of the iron-maker and the steel-maker, has always been the utilisation of the heat contained in slags. It is not so many years ago that the slags themselves were wasted. At the present day the uses of the various types of slags are many and various, but hitherto their sensible heat has been unutilised. Accordingly, the paper by Mr. W. L. Johnson, of Messrs. Bell Brothers, on this enormously important industrial problem, recording as it does the results of tests that have been in progress for four years, is well worth studying. The principle of the method has been to generate steam by allowing the molten slag to flow into a suitable generator and to utilise it in an exhaust steam turbine. In the first tests the steam was utilised direct from the generator, but these were abandoned in favour of an indirect method in which a water heater and a heat exchanger were introduced between the primary generator and the turbine. The calandria used was a "Kestner single-effect climbing film evaporator," and consists of two parts, the calandria proper and the separator. A certain amount of sulphur was deposited, but there seems to have been very little corrosion of the tubes of the heater. A vacuum of about 9 in. of mercury was maintained in the separator so that the water boiled at 90–91° C. "With steam from the slag at 100° C. and keeping a temperature in the calandria of 91°, the mean of twenty-two experiments gave 173 gallons of water evaporated per hour, and the average steam per hour condensed in the calandria and heater was 190·2 gallons. The feed water entered the heater at an average temperature of 24·6° C., and entered the calandria at an average temperature of 80°, *i.e.* 91 lb. of clean water was evaporated for every 100 lb. of steam from the slag." The amount of available steam from the slag was determined by condensing and measuring it. Seven experiments gave as a mean 1017 lb. per ton of slag. Deducting 6·6 per cent. for escape with the incondensable gases, 950 lb.

remain, and 90 per cent. of this gives 855 lb. of clean steam available for the turbine. "Since modern exhaust steam turbines with a full load and a vacuum of 28½ in. can be guaranteed under the above conditions to use not more than about 27 lb. per horse-power, this gives 31·6 horse-power per hour per ton of slag per hour."

In his paper on the use of liquid ferro-manganese in the steel processes, Mr. Axel Sahlin points out most of the methods of adding ferro-manganese are wasteful both from the point of view of heat efficiency and the percentage of manganese oxidised. He describes a new type of arc furnace invented by Mr. Ivar Rennerfelt, which he claims has been successfully used for this purpose. This furnace is fitted with three electrodes so placed that, when the current is turned on, the arcs, instead of passing directly between the points of the electrodes are deflected downwards, forming an inverted arrow-head or "fleur-de-lys" with a height of 6 to 12 in. Adjustment is made so that the point of the "arrow-head" impinges on the surface of the metal. Manganese smoke was noticed for a few minutes after charging, but then ceased to be evolved. The tests which have been carried out indicate that for the melting of one ton of 79 per cent. ferro-manganese, charged into an empty and pre-heated furnace, about 450 units are required. This corresponds to a furnace efficiency of 78–79 per cent., and is very much better than anything that has been achieved with other types of electric furnace. Moreover, analyses showed that there was not only no loss of manganese and iron in the melting process, but even a gain of 0·6 per cent. in each case.

The industrial production of electrolytic iron now appears to be entering the "practical" stage. An account is given by Prof. Guillet of the manufacture of such iron in the form of tubes of considerable size. The direct production of sheets is also contemplated. The iron is deposited on a revolving kathode from a neutral solution of iron salts (the composition of which is not given), the electrolyte being maintained neutral by the circulation of the liquid over the surface of the iron. From time to time the liquid receives additions of iron oxide with the object of reducing the deposition of hydrogen on the kathode. In this way currents of 1000 amperes per square metre have been successfully employed, and an iron of excellent quality is said to have been obtained. Analyses show that it is very low in the usual impurities even when prepared from very impure pig-iron. When freshly prepared it is hard and brittle, partly on account of the fact that it has been deposited in a condition of strain and partly because it contains hydrogen. The former aspect is well seen in the photomicrographs, which reveal a typical martensitic structure, and it is interesting to observe that the normal polygonal structure of a pure metal is not obtained until the annealing has been carried to 800°–900° C. Photographs of the crushing tests of tubes indicate a very remarkable degree of plasticity. The direct production of sheets without rolling would certainly be an important technical achievement and such material on account of its high degree of purity would have important applications in electrical machinery. H. C. H. CARPENTER.

PAPERS ON HEREDITY.

STUDENTS of heredity have followed with the greatest interest Dr. L. Doncaster's experimental and cytological work with the Magpie Moth (*Abraxas grossulariata*). In the last number of the *Journal of Genetics* (vol. iv, 1914, pp. 1–21, plates i–iii) he brings forward further interesting results on the relations between chromosomes, sex-limited transmission, and sex-determination in that insect. He confirms the observation that in a strain of Abraxas, which in each generation produces families consisting entirely of females, the oogonia have only fifty-five chromosomes instead of the fifty-six normal to the species. It is thus established that the females are here heterozygous as regards sex-character, whereas in many insects the males are known to be heterozygous. Dr. Doncaster found that one female of this remarkable strain carried fifty-six chromosomes, while other females of the same brood had clearly fifty-five. "In the same brood there was failure of sex-limited inheritance of the *grossulariata* character [as contrasted with the factor producing the variety *lacticolor*] in two cases, in such a way that the *grossulariata* mother transmitted this character to two of her daughters (out of a total of sixteen) instead of, as normally happens, only to her sons. It is suggested that this may be correlated with the extra chromosome found in one female of this family, the *grossulariata*-bearing chromosome having become separated abnormally from the sex-chromosome."

Another noteworthy recent paper on the problems of inheritance is Dr. Leon J. Cole's account of the relations of the principal colours in Pigeons (*Rhode Island State College*, Bulletin 158). He concludes that there are four principal factors concerned—two for the pigments black and red, an intensity and an extension factor. The absence of the intensity factor makes black dun and red yellow, while the absence of the extension factor produces blueness. "Reversion to the wild blue Rock Pigeon type in domesticated pigeons is due simply to a recurrence of the particular combination of factors which are present in *C. livia*." White plumage is explained by the presence of an unknown number of pigment-inhibiting factors which are supposed to check the appearance of colour on different regions of the body.

THE PLACE OF WISDOM (SCIENCE) IN THE STATE AND IN EDUCATION.[1]

"*So soon as men get to discuss the importance of a thing, they do infallibly set about arranging it, facilitating it, forwarding it, and rest not till in some approximate degree they have accomplished it.*"—CARLYLE.

THIS, doubtless, is a true statement; the difficulty is, however, to persuade men of the importance of a thing. We come to persuade you. As an association we are now eighty-four years old: our main purpose has been to obtain a more general attention to the objects of science and a removal of any disadvantages of a public kind which impede its progress—let me also add, its application to culture and to the public service.

By holding meetings, year after year, in the principal towns of the British Isles, the association has at least brought under notice the fact that science is a reality, in so far as this can be testified to by several hundreds of its votaries meeting together each year to consider seriously and discuss the progress of the various departments. On the whole, dilettanti have had little share in our debates. The association has already carried the flag of knowledge outside our islands, thrice to Canada and once to South Africa; now, at last, we make this great pilgrimage to your Australian shores; still we are at home. What message do we bring with us?

In 1847, when this city was but an insignificant town, it was visited by an Englishman who afterwards became eminent not only in science but also

[1] From an address to the Educational Science Section of the British Association at Melbourne, August 14, by Prof. Henry E. Armstrong, F.R.S.

as a literary man—Thomas Henry Huxley; he was then surgeon on board the surveying ship *Rattlesnake*. In 1848 Huxley visited Sydney, and there met the gracious lady, only recently deceased, who became his wife. In after years he achieved a great reputation on account of his services to education.

Lecturing in London in 1854, he defined science as "trained and organised common sense"—a definition often quoted since; none could be more apposite, though it must be remembered that "common sense," after all, is but an uncommon sense.

A few years later, in a public lecture at South Kensington, Huxley spoke to the following effect:—

"The whole of modern thought is steeped in science; it has made its way into the works of our best poets and even the mere man of letters, who affects to ignore and despise science, is unconsciously impregnated with her spirit and indebted for his best products to her methods. I believe that the greatest intellectual revolution mankind has yet seen is now slowly taking place by her agency. She is teaching the world that the ultimate court of appeal is observation and experiment and not authority; she is teaching it the value of evidence; she is creating a firm and living faith in the existence of immutable moral and physical laws perfect obedience to which is the highest possible aim of an intelligent being.

"But of all this your old stereotyped system of education takes no note. Physical science, its methods, its problems and its difficulties, will meet the poorest boy at every turn, and yet we educate him in such a manner that he shall enter the world as ignorant of the existence of the methods and facts of science as the day he was born. The modern world is full of artillery: and we turn our children out to do battle in it equipped with the shield and sword of an ancient gladiator.

"*Posterity will cry shame on us if we do not remedy this deplorable state of things. Nay, if we live twenty years longer, our own consciences will cry shame on us.*"

These words were uttered in 1861. Now, after more than fifty years, not twenty merely, we still go naked and unashamed of our ignorance: seemingly, there is no conscience within us to cry shame on us. I have no hesitation in saying that, at home, at all events, whatever your state here may be, we have done but little through education to remedy the condition of public ignorance which Huxley deplored. In point of fact, he altogether underrated the power of the forces of ignorance and indifference; he failed to foresee that these were likely to grow rather than to fall into abeyance. In England, what I will venture to term the Oxford spirit still reigns supreme—the spirit of the literary class—the medieval spirit of obscurantism, which favours a backward rather than a forward outlook.

Wherein was Huxley out in his forecast? In 1861 the claim of science was already strong, but think what has been done since that time—what we can now assert of its conquests! In the interval, even within my recollection, the whole of our ironclad fleet has been created, rifled cannon, smokeless powder and dynamite have been introduced, and this last, in combination with the discovery of the causes of yellow fever and malaria, has made the Panama Canal possible, an entirely revolutionary work of man's interfering hands. The *Great Eastern*, which could not be launched at first on account of her size—as a lad, I saw her sticking in the stocks—was always a failure, because she was outside the fashion of her time, yet has given rise to a host of ocean leviathians of far larger size; the steam-turbine has entered into rivalry with the reciprocating steam-engine; cold storage has revolutionised ocean transport, so that fresh food can be carried from this continent to remote England and Europe. Electricity, then a puling infant, is grown to giant size; not only have we deep-sea telegraphy and mechanical speech in the form of the phonograph and telephone, but wireless communication, the electric light, electric transmission of power, electric traction—even the waterfalls of the world are tamed through the turbine and made subservient to our will for motive purposes or in the production of temperatures bordering on those of solar heat, by means of which, too, we can draw food for plants, at will, from our atmosphere by combining its constituents into the form of a fertiliser. The use of oil-fuel in the internal-combustion engine has been made possible and, in a few short years, our streets have been cleared of horse conveyances and crowded with motor-vehicles; such engines are coming into use everywhere and have enabled us successfully to perform the feat which Dædalus vainly attempted—we even talk of flying from New York to London, across the vast Atlantic, to spend the week-end. The cyanide process has been introduced into gold-mining and is enabling us to unearth a fabulous wealth; a vast array of gorgeous colours has been produced, and Dame Nature so outwitted that we make indigo and madder out of the tar which in old days was put only upon fences; Pasteur's work has made Listerism possible, so that nothing is now beyond the surgeon's art and bacteriology is become the handmaid of preventive medicine and sanitary science; not only paper but a silk is made artificially from wood-pulp and the finest of scents are conjured out from all but waste materials. A multitude of other discoveries of practical value might be referred to.

Not so long ago, when scientific research was spoken of, the cry was always *Cui bono?* What's the good of it all? Now, no one has the patience to listen to a recital of the benefits accruing to mankind from its operation; for all the achievements I have referred to *are not the work of mere inventors* but primarily the outcome of scientific discovery: thus our modern command of electricity is very largely traceable to the labours of the great philosopher Faraday, who worked in an ill-lighted and cramped laboratory in the Royal Institution in Albemarle Street, London, with no other object than that of contributing to the advancement of knowledge.

Perhaps the greatest of all the scientific achievements of our time remains to be mentioned—the promulgation of the doctrine of evolution by Charles Darwin. Few perhaps can realise what this means for mankind, the intellectual advance it constitutes—that through it we have at last acquired full intellectual freedom and the belief that it rests with ourselves alone rightly to order our lives; that by it all dogmas have been undermined.

Science is come into being and has prospered only since freedom of thought was secured: on no other terms can it be. It is well that we should bear this in mind. The growth of numbers and of democracy may well involve a restriction of freedom in all directions—none are so intolerant as the ignorant.

If in science, to-day, we have something unknown to former civilisations, what is its influence to be on the future of the world, in particular on the future of the white people? If we are not to suffer the rise and fall which all previous civilisations have passed through—rather let me say, if the period of our fall is to be retarded beyond the period our forerunners enjoyed, it will be solely because we wield and use the powers science has put into our hands: not so much those of abstract science but the broad wisdom which the proper cultivation of science should confer; hence it is that I desire to urge the absolute importance of giving, through science, a place to the cultiva-

tion of wisdom in the State and therefore in education.

Clearly, two new forces are at work in the world: not science alone but also a broad and altruistic Socialism, both the outcome of the intellectual freedom man has acquired since the deposition of the Churches. The one is gradually leading us to base our actions upon knowledge and to be practical through the use of theory; the other is leading us gradually, though slowly, to have consideration for one another, to recognise how helpless are the majority, how greatly they stand in need of the guidance of the few who are capable of leading. But we shall need to order our Socialism by science to make it a wise Socialism. The signs are only too numerous that a wave of political despotism may come over us. Either, as time goes on, science will be more and more of service in guiding the social machine—or that machine will perish, from the very complexity of its organisation and the inability of the units to understand their place, to understand the need of subordinating their individual inclinations to communal interests; most important of all, to understand their inability to recognise and require competent leadership—for science is aristocratic in its tendencies: indeed, I shall claim that real science—wisdom—is for the very few.

With all the marvellous growth of achievement to which I have referred, there has been no proportionate growth of public intelligence. Our Admiralty, and to a far less extent our War Office, have called science into their service, but our public departments generally will have none of it. Even the elements of an understanding of the methods of science are not thought to be essential to the education of a Civil Servant; such knowledge is not required even in the highest branches of the Indian Service—no politician is for one moment supposed to need it: we are governed almost entirely by the literary spirit.

The spirit of the age, in fact, is in no way scientific, though ease and comfort are now provided on an unprecedented scale through the agency of science, the engineer acting as chief interpreter. Why do we still go naked and unashamed of our ignorance of "science"? One main reason is that the party in power is unscientific; but at bottom, I believe, the difficulty is a far greater one and probably innate in our disposition. It cannot well be supposed that man is by nature disposed to be scientific. The scientific fraternity, at any time, are, and probably always will be, but a small party—a set of freaks, sports from the multitude. They think and talk in a language of their own, as musicians do. The multitude may listen to them at times, with more or less of pleasure, as they do to music; but it is impossible, and probably always will be impossible, for the many to appreciate the methods and results of the scientific worker. Science, in reality, is a form of art and true artists are never numerous; moreover, it is admitted that they are born—like Topsy, they must grow, for they are not to be made in numbers. Our schools are for the most part in literary hands: and it would almost appear that literary and scientific interests are antagonistic, so unsympathetic has been the reception accorded to science by the schools.

Parenthetically, let me here deny the accusation not infrequently made by literary writers that the scientific fraternity are trying to oust literary studies from the schools. Nothing could be further from the truth. We are always craving for better literary training; our complaint is that the methods and subject-matter of literary training are far from being properly developed and, especially, that English is neglected in the schools. Huxley stated the real situation in saying, "Science and literature are not two things but two sides of the same thing."

The rise of science is due to the introduction of the experimental method. Mr. Balfour, in arguing, as he has done recently, that science rests upon many unprovable postulates and therefore does not differ in method from metaphysics, has made assertions which cannot be allowed to pass as correct. True science rests wholly upon fact and upon logic: all else is mere provisional hypothesis—a garment we are prepared to put aside at any moment if cause be shown. We are well aware that human nature is always intervening to spoil our work; it is human to err and false doctrine may easily occupy the attention for a time, but we are fully conscious of our limitations and prepared to admit them, whilst we feel that we are ever advancing towards security of knowledge.

The method of science, indeed, is the method of the Chancery Court—it involves the collection of all available evidence and the subjection of all such evidence to the most searching examination and cross-examination. False evidence may be tendered and for the time being accepted; but sooner or later the perjury is discovered. Our method, in fact, goes beyond that of the courts: we are not only always prepared to reconsider our judgments but always searching for fresh evidence; we dare to be positive only when, time after time, the facts appear to warrant a definite conclusion. But there are few instances in which we have travelled so far. The Newtonian theory of gravitation, the Daltonian theory of atoms, are two striking examples of generalisations which fit all the facts, to which there are not known exceptions; should any exception be met with we should at once doubt the sufficiency of such theories. In cases such as Mr. Balfour has discussed—the problems of metaphysics and of belief—experiment and observation are impossible: we can only resort to speculative reasoning; our belief, if we have one, is necessarily founded upon intangibilities and desires.

> There was a door to which I found no key:
> There was a veil past which I could not see;
> Some little talk awhile of Me and Thee
> There seemed—and then no more of Thee and Me.

The awful problem before us at the present time is to decide which direction we will take, to what extent and in what way we have the right to teach things which transcend our knowledge; the way in which truth lies may be clear to some of us but can never be to the majority. Those who wrap up such matters in a tangle of words are not helpful, to say the least. However mellifluous the terms of Bergsonian philosophy may be, they do not bear analysis when the attempt is made to interpret them; their effect is merely sensuous, like that of cathedral music.

But in order that she may lead, science must herself set an unimpeachable example—far too much that is now taught under the guise of science is pure dogma; in fact, the philosophy of the schools is mostly dogma. The true legal habit of mind is insufficiently cultivated and but rarely developed even among scientific workers—our logic is too often imperfect. In science, as in ordinary life, party politics run high and scientific workers are usually, for the time being, party politicians. We are too often crass specialists, always very human: indeed, whatever the lines along which evolution has taken place, they cannot well have been such as to favour in any considerable degree the development of the proclivities which distinguish the scientific inquirer: time after time, doubtless, he has been knocked on the head.

The difficulties under which science labours in our schools are partly internal, partly external. Tradition and the type of mind of the average teacher favour

set lessons and literary study by blocks of learners; the extra cost of the work is considerable, when the expense of the special requirements is taken into account; more time and more individual effort are demanded both from teacher and from taught; freedom is hampered by the need of considering the requirements of external examinations; finally, the universities have done but little to help, and though the schools have more or less unwillingly recognised that there is some value in scientific studies, in consequence of the persistent demands men such as Huxley have made, more especially because it is seen that there is money in them, none the less there is still no real demand for them on the part of the public. Of this and, in fact, of nearly all the real problems of education the public are too ignorant to be judges.

Having been more than forty years not only a teacher but also a student of students and of teachers, of educational methods, and of the conditions under which teaching is carried on, I have been led to form very definite opinions, the more so as I have been able to regard the problems not only from the pedagogic side, but also from that of the chemist and biologist—with some knowledge of the mechanism.

My view—and it is one that I desire to press to a logical conclusion—is that we must recognise that human ability is not merely a limited quantity but that it varies enormously not only in quantity but also in quality: the human orchestra contains a great variety of instruments differing in tone and range, but nature, like man, makes few instruments of superlative excellence, a vast number of very poor quality and only a moderate proportion of serviceable type. If science can tell us anything, it is that the democratic and republican ideal of equality is the veriest moonshine—a thing that never has been and never will be. And education can do very little to alter the state of affairs: it cannot change the instrument, at most it can develop its potentialities, and it may easily, by careless handling, do damage to the working parts. To take a special case, of interest at the moment, no contention is less to be justified, I believe, than that which has been put forward frequently, of late years, on behalf of women—that their disabilities are in no small measure due to the fact that we have neglected their education: give them time to educate themselves and they will be as men in all things. Years ago, at our Stockport meeting, I ventured to express the difference by saying that woman is not merely female man but in many respects a different animal: the two sexes have necessarily been evolved to fulfil different purposes. Nothing is more instructive in the history of modern educational progress than the fact that women have asked merely for what men have: at the universities they have attended the men's courses; not one single course have they demanded on their own account. Higher teaching in relation to domestic science so-called has only been thought of very recently and mainly because men have urged its importance. Most serious and, I believe, irreparable injury is being done to women, in London especially, by forcing them to undertake the same studies and to pass the same university examinations as the men: and the damage is done to the race, not merely to individuals, as the effect of education, whether direct or indirect, is clearly to diminish the fertility of the intellectual. Some day, perhaps, when the present wave of selfishness has passed over us, a rational section of women will found a woman's university where women can be taught in ways suitable to themselves without injury to themselves. In saying these things, of course, I am laying myself open to the charge of narrowness—in deprecation I can only say, that what we are pleased to call education is, for the most part, so futile in substance and in its results that I shall not mind in the least if I am accused of decrying it: in my opinion, we shall all be better without most of it, men and women alike. So far as so-called intellectual education is concerned, learning to read seems to me to be the one thing worth doing: at present it is the thing most neglected in schools.

To develop a rational system, we need to take into account man's past history and to apply evolutionary and biological conceptions. Education, as we know it and practise it, after all is a modern superstition—something altogether foreign to the nature of the majority of mankind; it is based on the false assumption that we can all be intellectual; whereas most of us can only use our hands. But the schools neglect hands and attempt the impossible by trying to cultivate non-existent wits. Man is doubtless pretty much what he was, and it is useless trying to make of him what he has never been.

We are seeking to educate all. What does this mean? Practically that we are seeking to teach all to read. But when they have learnt, what are the majority to read—what will they care to read? At the schools for young gentlemen, the reading taught hitherto has been mostly the reading of Latin and Greek. We know the result—the number of persons above school age who can and do read either language is negligible. Some of us learn French, scarcely any learn German, Spanish is all but neglected: when, therefore, we visit the Continent of Europe or South America we can only mumble a few words of the language of the country, and usually allow the foreigner we visit to speak broken English for us: few of us read his literature.

The vain attempt is made to put us in touch with the past but no real effort is exerted to bring us into contact with the present. We have not yet taught English in our higher schools, but are beginning to think of doing so—to this end, we are urging that attention be paid to so-called classical literature, forgetting, of course, that for the most part this was written for grown-ups and not as food for babes of school age.

The difficulty is still greater in the case of those who have only passed through the elementary schools—the literature that will appeal to most of these will be very limited in scope. Our newspapers show pretty clearly what will go down: not much—but it represents what is going on in life. In London, when the theatres are under discussion, it is often said that people want to be amused, not instructed; to cudgel our dull brains is a dull business to most of us. It seems to me that this doctrine should be applied more than it is in the schools. At all events, we shall do well to remember the words of the wise pundit in Rudyard Kipling's "Kim": "Education—greatest blessing when of best sorts—otherwise no earthly use."

To discover the best sort for each sort of student is our difficulty—who will do it? Here comes my point. Not the present race of schoolmaster or of educational authority. By placing classical scholars in charge, we seem unconsciously to have selected men of one particular type of mind for school service—men of the literary type; and this type has been preferred for nearly all school posts, mainly because no other type has been available, this being the chief product of our universities. Such men, for the most part, have been indifferent to subjects and methods other than literary—I verily believe not because they have been positively antagonistic or lacking in sympathy, but rather because of their negative antagonism: of an innate ability to appreciate the aims and methods of any other school of thought than their own, especially on account of their entire

ignorance of the experimental method. I believe, moreover, that the difference is fundamental and temperamental, not to be overcome by training. Oxford, owing to the bait of its classical scholarships, seems to have attracted an entirely peculiar type of ability and to stand alone in consequence; at Cambridge, owing to the hold obtained by mathematics, the field has been divided, but the mathematician, in his way, is often as unpractical by nature as the classic; fortunately, of late years, owing to the rise of the medical school and that of natural science, other elements have been introduced and the university has a future of infinite promise in consequence, if it will but realise that its primary function is to inculcate wisdom rather than to give purely professional training.

Sympathy is only begotten of understanding; the literary type of mind apparently does not and cannot sympathise with the practical side of modern scientific inquiry, because it has neither knowledge of the methods of experimental science nor the faintest desire for such knowledge.

We need a more practical type of mind for our schools. Pessimist though I may appear to be, having watched with close attention, all my life, the great struggle that has been going on in and between schools—having had the great good fortune also myself to be one of the early workers in the province of technical education, and having been associated with the development of one of the greatest of our boarding schools (Christ's Hospital)—I am, of course, aware that very great progress has been made, and am, in every way, hopeful of the future in store for those who are unaffected by present prejudices. In my experience, the men to whom the progress has been due have, in all cases, been trained in a broader school than that of Oxford; the few escapes from Oxford who have been successful reformers have been the exceptions which prove the rule, as they have shown themselves to be gifted with practical instincts: to such men the Oxford literary training has been of extreme value. Oxford will not gain its full value until all types of ability are represented in fair proportion by its students, not one almost exclusively. When this step is taken, the incubus of the Oxford spirit will no longer be upon us: it will then be possible for us to regard education as "a preparation for life"—a formula often used but usually honoured, hitherto, in the breach, rarely if ever in the observance, in our schools.

There must be no misunderstanding. The representatives of literary training rely chiefly on a past into which it is well not to look too closely and must always work with borrowed capital in the days to come: our side has no distant past worth speaking of, but is hopeful of a glorious future, in that it will always be adding to its knowledge; we desire to do their party all possible justice, and shall ever be in need of their assistance and more than grateful for the service they render us; but it must be war to the knife if they will not recognise that, in a progressive age, they cannot lead any longer, that we shall decline to put up in future with the conceit and narrowness of outlook of the classical scholar.

The argument I have applied to the teacher is equally applicable to the taught—boys and girls, indeed students generally, are of different types; they have different orders of ability and cannot be treated as if all were alike. In the beginning, we may tempt them with all sorts of scholastic diet, but only, in the main, in order to discover their aptitudes; when these are found, they should be the main line of attack. In saying this, I am not arguing in favour of extreme specialisation but against time being wasted in attempting the impossible. Some of us can learn one thing, others another: the schools try to force too many into one mould. It is essential that we should try to lay certain foundations but useless to proceed when we find that some of them cannot be laid.

This doctrine is applicable especially to the selection of scholars and to the training of teachers and of evening-class students. We select our scholars almost entirely by literary tests—the result is that we select persons of literary aptitude rather than those gifted with practical ability for every kind of service: like necessarily breeds like. By insisting on "grouped courses" we too often oblige students to take up subjects to which they are incapable of paying attention with profit: most of us, probably, have found out that there are many subjects which we simply cannot learn, try as we may.

My own experience with students has satisfied me that they not only vary in ability but that the different classes are of very different types of mind: the engineer tends to be constructive but not analytical; the analytical introspective habit of mind is more highly developed in the chemist; the biologist rarely has mathematical proclivities. It is useless to attempt to teach all in the same way, and many can learn only very little.

The explanation of Huxley's failure to forecast the future of science lies, apparently, in the fact that men generally *are not* attuned to her ways. I am inclined to think that the "mere man of letters" *will continue* to ignore and despise science—he will lack the peculiar mental capacity to assimilate scientific teaching. Only the few will rise to a proper understanding of the mysteries and be masters of their subjects, though many may be trained to be skilful mechanics.

The extent to which the multitude can receive instruction is a matter of primary importance. If, as Huxley has said, the greatest intellectual revolution mankind has yet seen is now slowly taking place by the agency of science—if she be teaching the world that the ultimate course of appeal is observation and experiment, not authority; teaching it the value of evidence: then must we strive to teach all, in some measure, what constitutes evidence, what observation and experiment are.

I believe much can be done in this direction, having made the attempt with hundreds of unwilling students in my time, students of engineering who had not only made up their minds that they were not going to learn chemistry as it was not their subject, but were incapable of ever entering into the spirit of the work—one of my sons was amongst them. At an early period, having realised that it was useless to waste my time and theirs in the struggle, and that it would not help them in the long run, to give them chemical tips which they lacked the sense to appreciate and to apply, I made up my mind, therefore, that it was desirable instead to develop any detective or inventive spirit that might be in them, so advised them to read detective stories instead of a text-book and ask themselves what the stories taught them: how the detectives set to work. Their attention was secured by urging them also to think what would be their position, later in life, when they were called upon to act for themselves and to get new knowledge for themselves, if they had not learnt to think for themselves. We have then set them to work to solve a series of problems in the laboratory. The course, in fact, was a combined laboratory-lecture course, the lectures being on and always subsequent to the laboratory work. In not a few cases, in after years, when I have met old students, they have told me spontaneously that, much as they had objected to the pressure put upon them, our insistence on their learning to do something themselves had proved to be of extreme value. Long experience has convinced me that anyone who has once learnt to make simple measure-

ments and observations and to ask and answer a definite question experimentally is on a different mental and moral plane from that occupied by those who have had no such training.

Such teaching is possible even in elementary schools —given competent teachers; but a new race of teachers will be required to carry the work into effect, should it be decided to make the attempt at all generally.

The great mistake that has been made hitherto is that of attempting to teach the elements of this or that special branch of science: what we should seek to do is to impart the elements of scientific method and inculcate wisdom, so choosing the material studied as to develop an intelligent appreciation of what is going on in the world. It must be made clear, in every possible way, that science is not a mere body of doctrine but a method: that its one aim is the pursuit of truth.

If we are to progress in these matters, a system must soon be developed which is broader and better than that under which we now muddle along—at present the real problems of education are all but neglected; even if the official mind were capable and desirous of promoting progress, the work of administering rules and regulations—of keeping the machine going—is so great that no time is left for thought.

We have seen the error of our ways sufficiently to give up payment by results and are all but ashamed that we were ever misled by Robert Lowe to adopt such a soul-killing policy. But none the less our entire educational system is still in the grips of commercialism, and, in this respect, as a nation, we stand alone, I believe. Scholarships, prizes of one kind or another, examinations are the perpetual feast of British education. Examinations, in fact, are a regularised and very lucrative branch of industry—mostly in the hands of certain firms who diplomatically shelter themselves under the ægis of this or that educational body; but the universities are the greatest sinners. Valuable as examinations may be within certain narrow limits and for certain definite purposes, there is little doubt that our general ignorance is in no small degree determined by our worship of the examination fetish. So long as the system prevails, the education of our youth will not be in accordance either with their capacity or their requirements but on lines corresponding to those by which prize cattle are raised for show—they will be trained to develop some specially catching point.

The examinations are an inheritance from the literary rule. It is possible to test on paper whether a man be "well read," but faculty as distinct from capacity cannot be so determined. What is worse, by forcing students to commit a large body of doctrine to memory, the attention becomes fixed merely upon what others have done and little time or inclination is left them to acquire a knowledge of method—the faculty of thinking for themselves and applying their knowledge. No class suffers more seriously than medical students under the system—their preliminary training is all but entirely didactic, and the time spent upon it all but wasted; we need not wonder that medicine has made so little advance, the practitioners being in no way trained in the use of scientific method.

To improve our system we need to get rid of our blind British belief in "men of affairs," especially in the "man of business," so-called, really the man of commerce, as persons capable of ordering everybody's affairs and everybody's business. The commercial man, the financier or the lawyer, would never think of calling us in to manage his proper business—why should he be thought competent to manage ours? Results show that he is not, as my argument in this address would lead us to expect would be the case.

No one will seek, for one moment, to minimise the progress made or fail to recognise that infinite credit is due to those who have controlled the work of education thus far; hitherto, however, progress has been made in providing accommodation and getting scholars to school and college: the art of teaching has made no corresponding advance—nor will it, I believe, until the onus is cast more directly upon the teachers and they are forced to exercise greater forethought in the direction of collective action—until they are placed in a position to be sole managers of their own affairs and called upon to row together as entirely self-chosen crews. At home, excepting at our ancient universities, "governing bodies" are paramount everywhere—not the teachers; and too often the sense of responsibility and power of initiative of the teacher are further diminished by the interposition of a principal, who may be a man of all affairs except that in hand—the work of teaching.

If the conclusion at which I have arrived be correct —that science is not for the multitude and can never be generally appreciated or even fashionable—in view of the part which it is clearly destined to play in education and in daily life, on account of its infinite and far-reaching influence upon our well-being—the responsibility cast upon the few representatives of science is very great; in support of our civilisation and in order that wisdom may prevail more generally, they must organise its forces effectively.

Whilst individuality is the mainspring of scientific progress, collective action is required to provide full and proper opportunity for the workers and to promote the success of their inquiries. At present, scientific workers are organised merely for the purpose of providing means of publishing the results of their studies, in no way either for defence or offence; our societies are not effective even for the purposes of debate and criticism. Thus, our chief English scientific society, consisting of some 500 members representative of all the various branches of physical and biological science, is little more than a rabble—its fellows are such individualists that scarce half a dozen of us can ever agree to work seriously together for a common purpose, and the irresistible influence we might exercise if we could be unanimous as to our objective is lost to the community. Most unfortunately, the society has no influence whatever either on political or on public opinion; it makes no attempt either to guide the public or to give dignity and importance to the cause of science in the eyes of the community. Its meetings are dull, and its belated publications by no means represent the scientific activity of its fellows. The presidents of the society have too often been appointed at an age when the propagandist spirit is no longer paramount, when they have no particular scientific message left in them to deliver. And they occupy the chair too long; this arises chiefly from the fact that however clear each one of us may be that individually he is fully competent to hold the office, we all agree in finding some objection to every name that is suggested; to overcome this difficulty a short tenure is desirable, so that the compliment can be paid and encouragement given to the various sciences in turn; no one should be appointed to such an office who is more than sixty to sixty-five years old, as most of us have used up our ideas and have lost our virility by that age. The other officers also hold their positions too long, but members of the council have far too short a life—consequently all the power is centred in the official body; attempts that have been made to organise the whole society in sections representative of the various sciences have always been defeated by the official party.

Unless our scientific societies can be made more

generally effective, if scientific workers are incapable of learning lessons from administrative life, it stands to reason that the collective interests of science and of the body scientific must remain unrepresented and unvoiced—to the great detriment of progress and of the public.

Science must be organised, in fact, as other professions are organised, if it is to be an effective agent in our civilisation; the problems pressing upon us are of such magnitude and of such infinite importance that we can no longer afford to be without wisdom.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At Emmanuel College the exhibition of 50*l.* offered to a research student commencing residence in the present term has been awarded to L. Harrison, University of Sydney, for research in zoology. An additional exhibition of 50*l.* has been awarded to A. J. Philpot, University of London, for research in physics.

THE authorities of the Imperial College of Science and Technology, including the Royal College of Science, the Royal School of Mines, and the City and Guilds (Engineering) College, have information of some three hundred of their present staff and students who are now serving with the forces of the Crown, but they have no means of knowing to what extent old members of the college have answered their country's call. They desire it to be known that they will be glad to receive from these or their friends any particulars in respect of service and welfare which may be of interest to the college. The registrar will be glad to deal with any matters of this kind.

IN 1902 Dr. and Mrs. Christian A. Herter, of New York, gave to the Johns Hopkins University the sum of 5000*l.* "for the formation of a memorial lectureship designed to promote a more intimate knowledge of the researches of foreign investigators in the realm of medical science." According to the terms of the gift, says *Science*, some eminent worker in physiology or pathology is to be asked each year to deliver lectures at the Johns Hopkins University upon a subject with which he has been identified. The selection of the lecturer is to be left to a committee representing the departments of pathology, physiological chemistry, and clinical medicine, and if "in the judgment of the committee it should ultimately appear desirable to open the proposed lectureship to leaders in medical research in this country there should be no bar to so doing." The eighth course of lectures on the Herter foundation will be given by Dr. T. Lewis, lecturer on diseases of the heart, University College Hospital Medical School, London.

A COPY of the current calendar of University College, University of London, has been received. It is arranged on the same general lines as in previous years and provides full particulars as to the preparation for various degrees of the University, the scholarships, and exhibitions available, the facilities for post-graduate study and research, lists of graduates from the college, and much other useful information. A full account is given at the end of the volume of the assembly of the faculties of arts, laws, science, engineering, and medical sciences held last July when Sir Archibald Geikie presided. The provost, Dr. T. Gregory Foster, in his report on the work of the session 1913–14, pointed out that the progress of the college in the matter of buildings and equipment, as well as of endowment, continues to be greatly advanced by the work of the equipment and endowment fund committee, which was established in 1902. The completion of the new school of architecture and the erection of the building for the department of applied statistics and eugenics, as well as that for chemistry, had been seriously hindered owing to the labour disputes—in fact, little work had been done on either building for more than twenty weeks. The delay caused the greatest inconvenience, and it has also largely increased the cost of both buildings. The college is still short of the funds necessary to complete the equipment of the new chemical laboratories, and is looking anxiously for a benefactor who will come forward and provide the amount yet needed. It is also looking for a benefactor who will give the funds requisite for the purchase of All Saints' Church and its equipment as a great hall for the college. Rapid development of the work in almost every department, the demand and necessity for the institution of new courses and new departments, make it more difficult every day, with the present accommodation, to progress with the times and to meet the new requirements. The provost then went on to announce the grant of 30,000*l.* by the London County Council, and said that at least another similar amount is necessary to complete the works in progress. The calendar also includes a list of the honours and appointments of former students and other persons connected with the college, and a comprehensive list of original papers and other publications from the various departments of the college during the session 1913–14.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 5.—M. P. Appell in the chair.—G. **Bigourdan**: The passage of Mercury across the sun of November 7, 1914. Precautions are suggested for the observations of the forthcoming transit of Mercury.—J. **Boussinesq**: Addition to a recent note on the coefficient of filtration with sand with more or less fine grains. Calculation of the coefficient for the heterogeneous sand used by Darcy in his experiments.—L. **Landouzy**: The auxiliary hospital of the institute, No. 265.—A. **Laveran**: Experimental infection of mice by *Leishmania tropica*. Twelve white mice were inoculated, eight males and four females. None of the latter were infected, but six out of the eight males developed the disease, of which full details are given.—E. **Delorme**: General considerations on the treatment of wounds received in battle. Disease in the French Army is almost non-existent, dysentery and typhoid fever scarcely reaching the figures in times of peace. The conditions under which the present campaign is being carried out differ from those in 1870 in that battles are carried on continuously for days and weeks, and prompt removal of the wounded from the firing line is impossible. It follows that by the time the wounded are received at the rear suppuration has in many cases already set in. This especially applies to wounds caused by shrapnell and fragments of shell, in which infection by earth is common. As a result cases of gaseous gangrene and tetanus are widespread, and necessitate a complete change in the surgical practice at the front. Hospitals must now be concentrated as close to the firing line as possible, and the work to be done at these hospitals is sketched out. The frequency of complications due to gaseous gangrene and tetanus is specially mentioned, and the best means of dealing with them close up to the firing line discussed.—Remarks by A. **Laveran** on the preceding communication. Suggestions as to the best means of using anti-tetanus serum.—Observations of M. **Roux**. Remarks on anti-tetanus serum.—Reply of L. **Landouzy** to the communication of E. Delorme.—E. **Maurant**: Ephemeris of the

Delavan comet, 1913*f*.—Charles **Rabut**: New projective invariants.—P. **Helbronner**: The complementary geodesic triangulations of the high regions of the French Alps.—Aug. **Chevalier** and Olivier **Rœhrich**: The botanical origin of cultivated rice.—M. **Rollet**: The extraction of German bullets and fragments of shell by the aid of a powerful electromagnet.

CAPE TOWN.

Royal Society of South Africa, August 19.—Dr. L. Péringuey, president, in the chair.—T. F. **Dreyer**: The morphology of the tadpole of *Xenopus laevis*. Among other conclusions the author states that the epithelium of the gill-slits is continued into the glottis, which is in support of the theory that lungs and gill-slits are homologous.—R. **Issel**: A morphological study of *Strongylus douglasi*, Cobbold. A description of the ostrich wire-worm. Although the parasite was discovered in South Africa more than thirty years ago and has considerable economic importance in view of the mortality it causes among ostrich chicks, this is the first complete description of the helminth. It has been found that the parasite has a buccal cavity armed with teeth. This and other details were overlooked in the original description.—W. A. **Jolly**: The interpretation of the electrocardiogram. An explanation of the form of the electrocardiogram in the human being, under normal and pathological conditions, was put forward, based on a study of the electrical changes in the simple and slowly contracting heart of the tortoise, isolated from the body and caused to beat by induction shocks.—W. von **Bonde**: On the crystallography of anatase crystals in the auriferous conglomerate of the Witwatersrand. An occurrence of minute anatase crystals in the Rose Deep Gold Mine was described recently by Dr. R. B. Young. A number of these minute crystals was sent to the S.A. College for crystallographic examination. This work was undertaken by the author. Chemical examination showed the presence of titanium in the mineral. There is, therefore, no doubt as to the correctness of Dr. R. B. Young's determination of the mineral as anatase. A stereographic projection of all the observed faces suggests the possibility that anatase has not the symmetry hitherto assigned to it. An extended examination of a larger number of crystals is in progress with the view of confirming or disproving this suggestion.—T. **Muir**: Note on the product of a special n-line determinant by its central minor of the $(n\text{-}4)^{\text{th}}$ order. In Mr. Roseveare's paper on a proof that every algebraic equation of the n^{th} degree had n roots, an equivalent was given for the product of a special n-line determinant by its central minor of the $(n\text{-}4)^{\text{th}}$ order, the equivalent taking the form of an aggregate of products of pairs of minors of the $(n\text{-}2)^{\text{th}}$ order. For such a product an apparently similar expression of a general character has been known for some time, but it is found that this does not include the form given by Mr. Roseveare. This latter form is considered and a generalisation of it is worked out.

BOOKS RECEIVED.

Discoveries and Inventions of the Twentieth Century. By E. Cressy. Pp. xvi+398. (London: G. Routledge and Sons, Ltd.) 7*s*. 6*d*. net.

A Text-Book of Physiological Chemistry. By Profs. O. Hammarsten and S. G. Hedin. Translated by Prof. J. A. Mandel. Seventh edition. Pp. viii+1026. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17*s*. net.

Fishing and Philandering. By A. Mainwaring. Pp. xv+254. (London: Heath, Cranton and Ouseley, Ltd.) 6*s*. net.

The Spectroscopy of the Extreme Ultra-Violet. By Dr. T. Lyman. Pp. 135. (London: Longmans and Co.) 5*s*. net.

Department of the Interior. U.S. Geological Survey. Bulletin Nos. 556, 557, 571, 580 D, 580 E, 581 A, 585. (Washington: Government Printing Office.)

Department of the Interior. U.S. Geological Survey. Water-Supply Paper 323, 340 B. (Washington: Government Printing Office.)

Department of the Interior. U.S. Geological Survey. Professional Paper 90 C, 90 D. (Washington: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. lxiv., No. 2. (Washington: Smithsonian Institution.)

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 23.

PHYSICAL SOCIETY, at 8.—Presidential Address: Ionisation: Sir J. J. Thomson.

TUESDAY, OCTOBER 27.

ZOOLOGICAL SOCIETY, at 5.30.—Report on the Rhynchota Collected by the Wollaston Expedition in Dutch New Guinea: W. L. Distant.—The Foraminifera of the Kerimba Archipelago, Portuguese East Africa: E. Heron-Allen and A. Earland.—A Remarkable New Cirripede from the Chalk of Surrey and Hertfordshire: T. H. Withers.

THURSDAY, OCTOBER 29.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address by the President.

CHILD STUDY SOCIETY, at 7.30.—After Care of Mental Defectives: Miss E. Fox.

FRIDAY, OCTOBER 30.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Thomas Hawksley Lecture: Pumping and Other Machinery for Waterworks and Drainage: W. B. Bryan.

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